THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 54 Thursday, April 30, 1936 No. 1028

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3961 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT: 1935-36

J. E. Hurst, "Ashleigh," Trent Valley Road, Lichfield, Staffs.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, "The Priory," Oughtibridge, near Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: W. Scott, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.
East Midlands: B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, 122, Wellington Road, Bilston, Staffs.
Middlesbrough: D. Anderson, 147, Stockton Street, Middlesbrough.
Preston: P. Leyland, 7, Ashley Terrace, Farington, Lancs.
Lincoln: E. R. Walter, M.Sc., The Technical College, Lincoln.
Burnley: W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.
Falkirk: H. McNair, "Braewick," Larbert Road, Bonnybridge, Scotland.

National Ironfounding Employers' Association

President: J. Smith, Smith & Company (South Shields), Limited, Mile Street, South Shields.
Secretary: Harold G. Judd, C.B.E., 8, Frederick's Place, London, E.C.2.

The Institute of Vitreous Enamellers

President: Dr. J. W. Mellor, F.R.S., Sandon House, Regent Street, Stoke-on-Trent.
Chairman: W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary: Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President: G. T. Lunt, "Briardene," Newbridge Avenue, Wolverhampton.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2

Welsh Engineers' and Founders' Association

President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. *Telegrams: CIRA*
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

Contents

	PAGE
Spring and Autumn Conferences	335
The Rearmament Programme	335
Institute Elects New Members	336
Correspondence	336
Catalogues Received	336
The Foundry Salesman	337
Foundry Dust Control	337
Efficiency and Costs in the Foundry	338
The Second Welding Report	340
Sheffield Foundrymen's Election of New Officers	340
Sand- and Shot-Blasting and Silicosis	341
Students' Corner	342
Contraction	343
Key Industry Duties	348
Art and Craftsmanship	350
Teething Troubles	350
This Week's News in Brief	352
Trade Talk	352
Company Reports	352
Contracts Open	352
New Company	352
Personal	352
Obituary	352
Forthcoming Events	352
Raw Material Markets	354
Patent Specifications Accepted	354

Spring and Autumn Conferences

We have already drawn attention to two forthcoming conferences, the Glasgow Conference of the Institute of British Foundrymen, and the Acetylene Congress in London which unfortunately clashes with it. There will be, quite apart from these, a variety of meetings and conferences during the spring and autumn to interest founders. To begin with, the May Lecture of the Institute of Metals will be given on May 6, followed by the annual meeting of the Iron and Steel Institute on May 7 and 8, with the annual dinner on the earlier day. Later, from June 22 to 27, there is to be held an important international congress, the Chemical Engineering Congress of the World Power Conference, in London, under royal patronage, and after a large amount of organisation, the Congress will be supported by 48 countries, many of whom will send official delegates. The Congress is to be run in conjunction with a British Chemical Plant Exhibition, and an official Government Reception is to be held at Lancaster House. The number of Papers to be given is so formidable that, as at the Welding Congress, authors of Papers will not present them in person, but for each section of the Congress, chosen experts will act as general reporters, and will draw attention to those aspects of Papers which can most usefully be discussed. There are no less than twelve sections, the one most likely to interest founders being Section I, Ferrous Metals in Chemical Plant Construction, for which a well-known Sheffield metallurgist will act as reporter.

To wind up the season, we must mention the International Congress to be held in Düsseldorf, Germany, in September. Details are not yet available, but the importance of the occasion may be gauged from the fact that the Foundry Congress will take place from September 17, while on September 21, the autumn meeting of the Iron and Steel Institute will take place in the same city, to be followed by visits to important works in the western districts of Germany. It is hoped that as many as possible will be able to attend these meetings, which provide not only important technical information but useful business contacts. Düsseldorf holds pleasant memories for a number of people in the industry, who will be anxious to renew their acquaintance with it. The autumn programme is therefore to be a very full one, and we shall give, through our columns, the Papers likely to interest our readers, whether they are able to hear them personally or not.

The Rearmament Programme

In his valedictory address to the Federation of British Industries, Sir Francis Joseph, K.B.E., the retiring President, made some very cogent remarks of interest alike to both the Government and the industrialist. He very rightly, in his introduction to the subject, corrected a widely-held view that war and preparations for war are a help to industry, because of the adage that "work makes work." The cost of armaments has in the long run to be borne by industry, and this—after a boom period—causes the cost of production to be so high that definitely fewer people can afford to purchase the products at the consequent high level. After stressing that rearmament by the United Kingdom is "the only way," Sir Francis makes a triple claim of a reciprocal character for industry. He does so by posing the question, "What are the broad lines on which we think the Government would be well advised to act, so as to get the best possible results at the lowest cost?" His suggestions are:—

(1) Let their full programme be prepared, showing what are the urgent and less urgent needs.

(2) Let the greatest possible measure of co-ordination be achieved by the Purchasing Departments of the Navy, Army and Air Forces, so as to avoid their competing one against the other.

(3) There should be no interference in production for our export trade. This is vital.

For the accomplishment of these precepts, with which we are in entire agreement, it appears to us that the priority certificate scheme which was devised by Sir William Larke during the war should be resurrected, but with one essential difference. The war period was a time when all industrial efforts were directed towards the attainment of victory. At the present time there is a multitude of other interests which are of paramount importance for the maintenance of financial stability and continuity of the normal life of the populace. Thus, in the assessment of priority, the less urgent munition orders should not rank before urgent export orders, for, as Sir Joseph points out, it is extremely difficult to win back foreign customers once they have been lost.

The address made veiled reference to the poaching of skilled men, and pointed out that, whilst this merely hinders production and increases cost, it may benefit an individual firm, but not the industry of which it forms a unit. A word of warning is given as to the construction of new shops and extensions to present

(*Concluded on page* 336)

C

Institute Elects New Members

At a Council Meeting of the Institute of British Foundrymen, held at Middlesbrough, on April 18, 1936, the following were elected to the various grades of membership. (An asterisk denotes that election dates from October as membership is consequent on the formation of the new East Anglian Section.)

Subscribing Firm.

Ransomes & Rapier, Limited,* Waterside Iron Works, Ipswich, engineers and ironfounders.

As Members.

H. E. Anderson, engineer, Gillett & Johnston, Limited, Croydon; F. J. Cox, works manager, Remus Company, Limited, London, E.C.; A. F. Craig, engineer, A. F. Craig & Company, Limited, Paisley; G. C. Detlefsen,* superintendent of Nacton Works of Crane, Limited, Ipswich; J. L. Francis,* metallurgist and chemist, Reavell & Company, Limited, Ipswich; F. N. Gamble, M.A., representative, United Steel Companies, Limited, Workington; P. R. C. M. Harris,* metallurgist, Suffolk Iron Foundry (1920), Limited; J. Hepworth, J.P., M.P., managing director, Bradford Piston & Piston Ring Company, Limited; A. K. Jeffrey, foundry engineer, Winget, Limited, Rochester; E. L. Lester,* foundry manager, Blyth & Pawsey, Limited; C. F. MacFadyen, David King & Sons, Limited, Glasgow; F. C. MacLeod, secretary, Grangemouth Iron Company, Limited; W. McAllister, foundry foreman, A. F. Craig & Company, Limited, Paisley; B. Mohan, junior superintendent, Government Workshops, Dowlaishwaram; W. Moscrip, managing director, National Steel Foundry (1914), Limited; J. H. Myrtle, engineer, Morgan Crucible Company, Limited; N. P. Newman, assistant managing director, Newman Hender & Company, Limited; C. Portway,* foundry proprietor, Tortoise Foundry Company; W. F. Pyatt, refractories representative, Midland Furnace Lining Company; R. C. Shepherd, foundry manager, Ruston & Hornsby, Limited; A. W. W. Taylor, director, Taylor & Sons, Limited, Briton Ferry; F. E. Tibbenham,* foundry manager, Suffolk Iron Foundry, Limited; H. D. Todd, branch manager, United Molasses Company, Limited, Hull; W. F. Whyman, engineering representative, Foundry Engineers, Limited, Halifax; J. H. Williams, metallurgist, A/S Meraker Smelteverk, Koppera, Norway.

Associate Members.

F. A. Ahmedn, engineer; A. J. E. Baines, foundry progress man, Britannia Iron & Steel Works, Limited; E. Barnes, foundry foreman, Glenfield & Kennedy, Limited; R. J. Bartholomew,* foundry foreman, Reavells, Limited, Ipswich; H. A. Battely,* foundry chargehand, Crane, Limited, Ipswich; D. Carrick,* production engineer, Crane, Limited; V. W. Child,* assistant metallurgist, Crane, Limited, Nacton Works; J. K. Clement, works under-manager, Thomas & Clement, Limited; A. Colvin, foreman moulder, Vickers-Armstrongs, Limited; S. R. Crickner,* foreman—malleable section, Crane, Limited; N. Y. Djeng, foundry student, English Steel Corporation, Limited; J. M. Douglas, metallurgist, Glenfield & Kennedy, Limited; R. E. Dunnett,* production engineer—malleable section, Crane, Limited; V. Fisher,* foundry foreman, Hobbies, Limited, Dereham; B. Godber, works chemist, Thomas & Clement, Limited; W. H. Griffiths, works manager, Thomas & Clement, Limited; A. F. Hammond,* patternmaker, Reavell & Company, Limited; W. L. Hardy,* steel foundry foreman, Lake & Elliot, Limited; A. L. Hares, moulder, Royal Arsenal, Woolwich; A. Hatton, foreman moulder, Sheepbridge Coal & Iron Company, Limited; E. Illingworth, brass foundry foreman, Thomas Broadbent & Sons, Limited; F. G. Jackson, foundry foreman, John Ratcliff & Sons, Limited, Wortley; J. Ling, foundry foreman, Royal Ordnance Factories; F. J. McCulloch, metallurgical laboratory assistant, Glenfield & Kennedy, Limited; W. Millard,* foreman patternmaker, Crane, Limited; R. Reid, brass foundry foreman, Glenfield & Kennedy, Limited; N. E. Robson,* chief chemist, Lake & Elliot, Limited, Braintree; T. E. Rowland,* chargehand—malleable section, Crane, Limited; A. Smith, foreman patternmaker, Howard & Bullough, Limited; A. H. M. Squire, assistant foreman, J. Stone & Company, Limited, Deptford; A. N. Sumner, metallurgical chemist, Glenfield & Kennedy, Limited; J. Tregenza, foundry foreman, Blakeborough & Sons, Limited; F. Waller, assistant foreman moulder, Hepworth & Grandage, Limited; H. S. Ward,* foundry production assistant, Crane, Limited; A. Warrington, patternmaker, Air Ducts, Limited, Brentford; J. G. Wooding, clerk, castings section, J. & J. Siddons, Limited, West Bromwich; L. J. H. Wray,* assistant metallurgist, Crane, Limited; A. H. Wright,* moulder, Tortoise Foundry Company, Limited.

Associates.

N. Holder, moulder, Armstrong, Whitworth & Company, Limited; A. McCarrison, patternmaker, A. Low, Motherwell; J. Pryor, moulder, Crookhall Foundry, Consett Iron Company, Limited; W. E. Spraggon, moulder, Consett Iron Company, Limited.

Associates (Students).

E. Dainty, student, Alfred Herbert, Limited, Coventry; V. G. Ellis, foundry apprentice, Daimler Motor Company, Limited; T. Primrose, student of metallurgy, Royal Technical College, Glasgow; J. C. Wall, patternmaker, Sterling Metals, Limited.

The Rearmament Programme

(*Concluded from page* 335)

plant; and it is recommended that each individual industry should be consulted in order to ascertain how far they can meet the needs of the Government with existing plant. Once this information is available, then a decision can be taken as to the wisdom of erecting new factories and extending existing shops. The obvious rider is that every foundry should take steps to join its appropriate employers' association, in order that proper surveys can be made.

We find that, because of inspection, low profits and the supposed stigma to be associated with the manufacture of war material, few foundry owners welcome the change-over, but if each concern were to devote a section of its shops to the production of munitions, there should be no need for a complete metamorphosis of any section of the foundry industry. There is an immense reserve power in the foundry industry, and the added load, equitably distributed, should make normal production more profitable, with no increase in selling price, and at the same time deliver munitions to the Government at a reasonable price. If new buildings have to be erected and filled with new machinery, then, as there is no guarantee of continuity of production, a conscientious cost accountant will obviously take care of full depreciation in his estimates and his figures are liable to create a false standard for the rest of his section of industry, whereas with old-established concerns much of the original cost has been written off over a period of years.

Whilst not prepared as a piece of propaganda for employers' associations, we have seldom encountered a stronger argument for industrial co-operation than Sir Francis Joseph's address. The new conditions offer to many industrialists not a boom period, but one of balanced capacity production, which production engineers have for years been saying is an ideal really worth striving after.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Motor Cylinder Bore Wear

To the Editor of THE FOUNDRY TRADE JOURNAL

SIR,—I read with considerable interest Mr. A. Smith's Paper on "Motor Vehicle Cylinder Bore Wear" in your issue of April 9, and have summarised its contents as follow:—(*a*) The poor quality cylinder block is only produced by the outside foundry; (*b*) the responsibility of the defective block rests on the car manufacturer's buyer, and (*c*) the usual chemical analysis and physical test figures are insufficient to meet the requirements of the car manufacturer.

There are possibly one or two instances where the first premise is applicable, but personally I am of the opinion that there is just as much likelihood of the car manufacturer's own foundry being responsible as any other. I have followed very closely the various metallurgical experiments made by repetition foundries, and have found that it is invariably the manufacturer's own foundry which makes the greatest number of changes in methods and materials. Alterations in the foundry, however small, have to be carefully handled, as most foundry troubles take some time to develop.

It will be appreciated that the outside foundry cannot afford to take any risk that may endanger the quality of his castings, with subsequent loss of business. The situation, viewed from the manufacturer's foundry, however, is not so acute for various reasons. The buyer does undoubtedly hold part of the responsibility, by virtue of the fact he places the orders with the outside suppliers. On the other hand, it is a general practice that, before commencing production of large quantities of castings, a sample is submitted for inspection and general investigation by the technical staff of the car manufacturer. It is presumed that these checks are also made frequently during production.

The question of chemical specifications *versus* wearing properties is very complex, and although I agree that a "medium" phosphorus content improves a wearing surface, I fail to see that it is the complete solution to the problem, as there are other important factors to study. A good wearing cylinder block should have the following characteristics: (1) A very fine pearlitic structure with an abundance of fine graphite flakes, and (2) a phosphorus content sufficiently low to avoid local porosity, according to the design and bulk. A competent metallurgist, given the necessary materials should find no difficulty in controlling the cupola to produce an iron with the properties stated.

Yours, etc.,

G. D. PINCOTT.

80, Compton Road, Wolverhampton.
April 21, 1936.

Catalogues Received

Fractional Horse-Power Motors. Asea Electric, Limited, of 5, Chancery Lane, W.C.2, have recently issued a new list (A 38a) of their Century fractional horse-power motors.

Power Transmission. David Brown & Sons (Hudd.), Limited, Park Works, Lockwood, Huddersfield, in Publication F.487.2, entitled Radicon Worm Reducers, enter quite fully into the manufacturing methods they use, and why they have developed this space-saving unit. The balance of this 32-page catalogue is taken up with listing masses of specificational data and to illustrating and describing typical applications.

The Foundry Salesman

HIS PERSONALITY AND TACTICS

By ERIC N. SIMONS

In a previous article it was pointed out not so much what made a good foundry salesman as the methods of working that a good foundry salesman would adopt. The author had been told, however, that although he explained with some force how the modern salesman goes about his work from a systematic point of view, he had not shown how the same man excelled his predecessors in personal behaviour and characteristics. It was admitted that old-time foundry salesmen had several good personal qualities, and critics argue that no amount of efficiency in organisation of his time and approach will outweigh in a modern foundry salesman the lack of the old-timer's personal charm. Was it thought that the personality and tactics of the young generation were equal or superior to those that proved successful in the past?

He certainly is for the following reasons: The old-timer's appeal was a leisured appeal. The telephone was in its infancy. Transport was slower and less certain. The general mass of business was less. Mass-production and cost accounting and the various mechanisms of the modern office were still in embryo. There was, as everyone who recalls business in the spacious pre-war days will admit, more time. A foundry salesman did not only sell, he brought news, and there was time to listen to his news. If you wish to obtain a really good picture of an old-time salesman, Neil Munro gives one in one of his books of stories.

To-day, time presses. As the buyer sits in his office listening to the seller of castings, telephones ring at his elbow; directorial bells summon him from afar; a queue of other salesmen forms in his waiting room; sheafs of typewritten forms and letters accumulate for signature or attention; distraction follows distraction. The men may be identical basically, but the leisure has gone. Old Mr. Brown cannot diffuse his genial personality effectively in these harassing modern conditions. He is impeded, interrupted, cut short. His lumbering approach to the point ends, only too often, in a fostering of inattention on the buyer's part, followed by a hasty ending of the interview. He will have his successes. Here and there some buyer with an eye for humour and character will be appealed to by his old-world behaviour and mannerisms. But in general his failures will increase as his generation becomes more remote.

The modern foundry salesman, on the other hand, combines with the directive and efficient approach outlined in a previous article, no lack of personality or pleasing tactics. In the first place, what defenders of the old-timer fail to appreciate is that the very saving of the buyer's time is to-day a source of pleasure for him. The man who cuts out time-wasting tactics definitely and agreeably removes irritation from the interview. Instead of thinking: "Oh, Lord, here's Brown again, come to waste my time, poor old chap!" the buyer thinks: "Ah, Jones! He'll have the sense to know I'm busy, and he usually has something to tell me. I'll see him." Even if the interview is (as it would be from Brown's point of view) distressingly brief, it is pleasant. Each man, Jones and the buyer, recognises the other as a worker in modern conditions, comes to the point, and thereby establishes a certain mental sympathy at once.

Secondly, the modern foundry salesman is less florid in style. There is none of the "My boy, when you've been at it as long as I" attitude about him. He does not indulge in over-statement (based, only too often, on precisely that lack of exact knowledge which was one characteristic of some old-timers). Instead of saying: "You can take it from me, sir, that these castings will outlast any others you like to put against them, and when John Brown says that, he knows what he's talking about," he says: "Well, as for life, I have known instances where they've lasted two years in strong sulphite liquor. But that's exceptional, and I'm not going to claim it as typical. I think you could take twelve to eighteen months as a reasonable average, varying with circumstances."

Genuine Knowledge Appreciated

There is all the difference there between hazy dogmatism and genuine knowledge. The modern world of business is a sceptical world, used to discounting the exaggerated claims in certain advertisements and sales talks. The foundry salesman of to-day tunes his arguments and claims to the mood of his listener. The result is, again, pleasure for the buyer. He feels: "This man respects my intelligence. He knows that I shall not swallow hyperbole. He gives me credit for common-sense. Yet he knows what he is talking about, and I should say his claim is a fair one."

Here is another, and a striking difference between the two types of foundry salesman, the old-timer and the modern. It is based on an actual experience, though for obvious reasons names must be suppressed. A certain foundry used to do a very good business with a large customer. Their salesman was a likeable old fellow of the old school. He called regularly, and cultivated the buyer with some assiduity. They liked one another, and were extremely friendly. Nevertheless, the modern world intruded upon this pleasant relationship. Costs had to be cut, and the buyer found himself driven by circumstances beyond his control to transfer his orders from steel castings to forgings of a softer metal. Naturally, the turnover with this particular firm dropped. After one or two calls to find out why, the old salesman accepted the situation, and his calls became fewer and fewer. He ceased to regard this firm as one of his best customers, and considered them, therefore, less worthy of his geniality and his time, until the time came when he called scarcely once in two years. In other words, he gave up visiting them as no longer "worth it" because his commission from their orders no longer signified much to him.

Perseverance

Another steel foundry, however, employing a salesman of modern type, thought differently. Their salesman continued to call, even when his steel competitor was getting all the business. In due course, he learned that they had gone off steel altogether. But he continued to call, and in the meantime, scenting danger to other accounts of his from this transference to alloy forgings, he took the matter up with his steel foundry experts, and gave them no peace until they had definitely tested out the relative advantages of the two types of parts. Then, to his delight, it was discovered that actually the economy of light alloy forgings was no economy, and in the long run steel castings were undeniably less costly. At once the modern foundry salesman called upon the previous buyer of castings, and set to work to disprove the claim that steel castings were costlier. The buyer had missed the calls of the old-timer. And what is more, he resented his abandonment. He saw that the friendship between them had been a little too blatantly an "interested" friendship. This quiet, polite, sensible young man to whom he had hitherto turned a deaf ear, had not treated him in that way. He deserved a reward. He got it. A year later, when the old-timer, having a spare half-hour, called to see his former friend, he discovered to his astonishment that for twelve months or so his rival had been getting the very business that had once been his.

The modern foundry salesman trusts his technical men, uses them, stimulates them, feeds them with information about the needs of the market. Only too often, the old-timer regarded them as his legitimate enemies, the people who turned out "disguised sponges," let him down by bad delivery, and refused to meet competition by cutting prices.

Too Easy-Going

In one respect, since fairness is essential, the old-time salesman scores over the modern. He had what, for want of a more expressive term may be called "guts." If there was a good steel casting order going, he would not hesitate to get up at six or five in the morning, catch an early train, and go after it. He would cut his lunch if necessary. He would foot-slog ten miles if there was something worth-while at the end of it. The modern foundry salesman takes it, on the whole, more easily. Automobiles have rendered him largely independent of trains, and the trouble and time spent in housing and unhousing them tend to make him delay his departures to the warmer after-breakfast hours. He is less ready to explore the by-ways where roads are bad, or indifferent. He likes to get back to his hotel "before lighting-up time." He is less ready to spend the night in poor hotels in little towns, and will cut an hour of his working day in order to accomplish the homeward run to his own abode. Nevertheless, these softer ways do not completely outweigh his other qualities.

Finally, there is the important point that the modern foundry salesman has usually had an engineering or drawing-office training. He can send in a reasonably accurate sketch of a casting for which a price is wanted. He can tell whether design is at fault in a part. He can suggest a suitable metal for a particular job. He may not be right every time, but at least he is usually on the right track, and because he knows so much, he seldom annoys the foundry by the captious criticisms and excessive worship of the customer's point of view that only too often left the old-timer in bad odour with his own works. What it reduces itself to is this, that the modern foundry salesman employs methods which fit his particular age. The old-timer does not. Thirty years hence the methods of to-day may be as obsolete as those of yesterday are now.

Foundry Dust Control

The American Foundrymen's Association, at its 1935 convention in Toronto, held two important sessions related to dust control, health hazards, and employer responsibility, and the four Papers presented at these meetings, together with their discussions, have been issued in reprint form by the A.F.A.

Industrial Health Hazards and Employer Responsibility are discussed from the medical and administrative standpoints by Dr. W. J. McConnell, Director, Industrial Health Section, Metropolitan Life Insurance Company, and Donald E. Cummings, Field Director, Saranac Laboratory, Saranac Lake, N.Y. S. D. Mexley, Chief Engineer, American Cast Iron Pipe Company, Birmingham, Ala., reviews the mechanical aspects of dust collection in foundries, presenting data on various types of collectors and dust characteristics, while J. D. Leitch, of the Ontario Department of Health, discussed dust as a health hazard, and equipment for removing dust. The pamphlet contains, in addition to these four Papers, a report of the discussions developed by those present, which give many interesting views, showing the serious attention being given by foundrymen to control of dust and improvement of health conditions in their plants.

Efficiency and Costs in the Foundry

By E. LONGDEN (Foundry and Patternshop Manager, Craven Bros. (Manchester), Limited)

In how many cases would it be possible to reply immediately and satisfactorily to the following questions?:—What is your actual and possible output of castings per man-hour? What is your actual and possible cost per ton of castings? What is your percentage indirect to direct wages?—and so on.

These questions relate to the problems of management and will be answered in the light of circumstances. If the owners or directors of a foundry are satisfied generally without *detailed* cost returns, then matters stand well and may represent a mark of confidence in the foundry. After all, whilst detailed costs outline the various factors which make up final costs, it is the action of the foundry staff which will determine such costs in the main. The most elaborate and completely detailed scheme of costing will only add to costs. At the same time, the best reason for *elaborating* a costing system is to enable the foundry to estimate satisfactorily for future work. If a detailed costing system points to leakages in expense, then the foundry is not being run efficiently.

By "efficiency," reference is made to the best use being made of all the virgin materials and the effective human and mechanical power and force in the workshop. Therefore, to use material, power and energy in the best way one must control them so far as can be done. Generally, control can be classified under the following categories:—(*a*) Control of operatives—senior and junior; (*b*) control of the means of production; (*c*) control of method; and (*d*) control of expenditure.

Personnel Control

The control of workpeople comes first by a very large margin. No piece of work will be executed so well by any operative, no matter how great his ability, as when due consideration is paid to the development and settlement of the mind through a satisfied conscience. Such a psychological aspect can best be expressed and conveyed through character and personality as well as general ability in the men who are appointed to lead and control. The human element is affected for good or ill by all aspects of control.

The control of method, expenditure and the means of production are dependent on the ability and experience of the executive, modified by his personal influence in control of workpeople. Costs of production are, therefore, determined by efficiency in control.

Basis for Costing

It is almost impossible to formulate a costing system which is universally applicable; but one can build on basically accepted principles, admitting that in working out details only averages and proportions can be taken for future guidance.

When costing a casting, it is usual to base the calculation on skilled labour—moulding and core-making—and, when convenient, dressing, adding to the identifiable labour a percentage oncost for unallocable labour, moulding tackle, materials, power, light, plant, maintenance, transport, depreciation, obsolescence, supervision, clerical and office expense, management and administration charges, rates and taxes, and insurance, etc. Because of its very practical and general application, the writer has always worked on the foregoing basis. In most cases it is better to omit dressing as a direct allocable charge and merge it into the general oncost. The oncost charges are modified at the end of a costing period to meet changing and changed conditions.

Adjusting Variables

Not all founders are quite satisfied with the costing based on skilled labour plus a percentage oncost and metal. It is therefore necessary that provision be made for modifying the charges in the light of information tendered by the practical foundry staff. To take care of variations, a plus or minus calculation must be made to standard figures. If moulding and coremaking time be taken as the best basis for calculations, one must not pretend that one is approaching measurably near to a scientific-costing system. On the basis mentioned, it is quite probable, and in many cases certain, that an intricate casting will bear a smaller burden of overhead charges than a plain casting. A hammer block or ingot mould may cost less than sixpence per cwt. in direct labour, against upwards of twelve shillings per cwt. for an intricate engine-cylinder casting.

The system outlined in these notes takes care of any changes in manufacturing methods which may occur. If moulding machines are introduced there will be a fall in direct labour, but it is possible to have an increase in comparative and actual indirect labour costs, also for more power, maintenance, light, crane capacity and, perhaps, more floor area. In a costing system which simply adds a standard percentage on direct labour for indirect and overhead costs, changes, such as when introducing moulding machines, may set up a false idea or value of such mechanical aids, and at the end of a year, what have been superficially calculated as enormous reductions in direct labour costs, have to be written down somewhat in the light of increased expenditure in other directions.

Dealing with "Wasters"

Rejected or "waster" castings are made in all foundries and should be included in the general charges as a contingency risk when estimating or quoting for castings. Specially risky castings should carry proportionately higher contingency charges.

An interesting point arises out of the usual statement regarding the actual loss of rejections in the foundry. It is the general rule to provide a statement which indicts the foundry with the total loss—labour, oncost and metal—but crediting the foundry with the returned casting at scrap value. Actually, such a statement is only correct when a foundry is producing to capacity. There are a number of overhead charges which cannot be allocated truly to the loss of a defective casting until the foundry is working to full, or nearly full, capacity and the lost casting has excluded the making of an equal volume or value of castings. There are certain service, fixed and establishment charges, and standing and general charges which will not be increased by the loss of a casting until working to 95 per cent. or more of capacity. Again, the crediting of the returned casting at scrap value only, is not actually the true situation. To the founder who knows his job the returned scrap casting possesses a higher value than general scrap because it is of known quality, and can be used to take the place of ordinary mixtures of pig-iron, shop returns and general scrap. It is very probable that the true loss of a rejection to a general foundry not working to 95 per cent. capacity is in the region of 55 per cent. of the book value. Really, it is only the statements which accompany rejections to which one can object, because the true loss is reflected in the periodical and total costs.

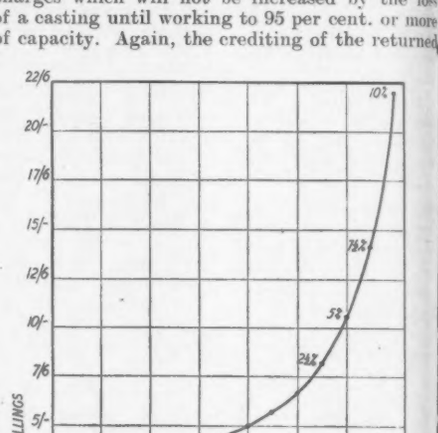


FIG. 1.

TABLE I.—*Foundry Group Operating Cost Return for a Grey-Iron F*

Departmental code letters. F. Moulding. P. Patternmaking.		Current charges or prime costs.				Unit-tons.	Service charges.				Unit
Code letter.	Operating section.	Direct wages.	Indirect wages.	Supplies.	Total.	Expense per unit.	Repairs and maintenance.	Heat, power, light.	Freight and general transport.	Total.	Exp
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£
F.M.	Moulding	3,000 0 0	1,500 0 0	500 0 0	5,000 0 0	5 0 0	250 0 0	75 0 0	2 10 0	327 10 0	0
F.C.	Coremaking ..	1,500 0 0	250 0 0	250 0 0	2,000 0 0	2 0 0	75 0 0	40 0 0	—	115 0 0	0
F.D.	Dressing	600 0 0	125 0 0	25 0 0	750 0 0	0 15 0	10 10 0	17 0 0	52 10 0	80 0 0	0
F.F.	Furnace-metal ..	—	125 0 0	4,875 0 0	5,000 0 0	5 0 0	2 0 0	5 10 0	12 10 0	20 0 0	0
F.A.	After treatment ..	20 0 0	10 0 0	20 0 0	50 0 0	0 1 0	2 0 0	2 10 0	2 10 0	7 0 0	0
F.P.	Production pattern	25 0 0	2 10 0	10 0 0	37 10 0	0 0 9	—	2 10 0	—	2 10 0	0
P.O.	Patterns—original	160 0 0	40 0 0	62 10 0	262 10 0	0 5 3	10 0 0	7 10 0	5 0 0	22 10 0	0
	Totals	5,305 0 0	2,052 10 0	5,742 10 0	13,100 0 0	13 2 0	349 10 0	150 0 0	75 0 0	574 10 0	0

A Suggested Scheme

The following costing scheme and schedules are not expected to be altogether acceptable in all types of foundries. The Cost Operating Return statement scheduled in Table I is based on the principle of allocating an equitable apportionment of all overhead charges to the various sections in the foundry and allied departments. Also, all indirect labour is correctly allocated except such as is accounted for in the overhead expenses for general stores, yard, watchmen and transport, etc.

The system can be modified to suit different types of foundries. One foundry may be able to group the whole of its casting production under a single classification, whilst another foundry may require as many as twelve classes or groups, but the basic and fundamental principles remain the same. The schedule shows the grouping of the various costs—prime costs, overhead charges and material under seven heads. The grouping may be modified to suit any particular foundry; but, generally, the groups enumerated will cover the full activities of a general foundry and allied departments.

Grouping Explained

Each section, or group, is readily recognised during the various stages of manufacture and costing by code lettering, such lettering being, as nearly as possible, the initial letter of the word or words forming the names of the section, thus:—F—Foundry; P—Patternmaking. The code letters are hereinafter detailed in the side headings.

F.M.—Moulding Department.—The moulding sections will include all operations connected with the construction of moulds, the preparation and use of sands and other materials and pouring of castings.

F.C.—Coremaking Department.—The coremaking section will carry through the production of cores and wherever advisable the preparation of sands as well as the consumption of same.

F.D.—Dressing Department.—The dressing section costs embrace the cleaning and fettling of castings after receipt from the moulding shops.

F.F.—Furnace and Metal.—The furnace and metal section includes all expenditure connected with cost of material and its handling in and out of the melting furnaces.

F.A.—After Treatment.—The after-treatment departments will carry expenses of any special treatment to which castings are subjected after passing through the dressing shops, such as annealing, pickling, enamelling, tinning, etc.

F.P.—Production Patternwork.—The production patternwork section will carry all costs incurred in producing special patternwork in metal, wood or other material from original or virgin patterns and which may be necessary for improving or increasing the productivity of the moulding and coremaking departments. A proportion of these costs to be borne by the original patternwork section for expense saved in pattern renewals.

P.O.—Patternwork Original.—The ordinary patternshop expenses will include costs incurred in producing original or virgin patterns from drawings or blue-prints and a proportion of the cost of producing permanent and production patternwork for expenses saved in renewing patterns.

The figures in the cost-return schedule, Table I, are hypothetical but near enough for illustration. In the grand total it will be noted that the final cost is £20 12s. per ton of good castings, in which cost is included original patterns. For castings alone, which includes expenses of permanent production patterns, and pattern equipment, etc., moulding costs are £8 11s. 6d., core costs £3 3s. 10d., dressing £1 9s. 7d., and metal costs £5 13s. 5d.

The schedule embraces all classes of work in a large foundry producing, in round figures, 1,000 tons for a five-week period of various classes of castings. The output may be divided into categories of manufactures such as:—(A) Oil-engine castings; (B) petrol-engine castings; (C) Steam-engine castings; (D) machine-tool castings; (E) hydraulic-machinery castings; (F) pump castings, and (G) machinery castings, and so on.

The categories of castings can be further classified into types of castings as when producing, say, for oil engines:—

A1 —Flywheels.
A2.—Cylinders and waterjackets, when separate.
A3.—Breech ends or combustion chambers.
A4.—Pistons.
A5.—Liners.
A6.—General.

Efficiency Factors

Very interesting and helpful information can be obtained from an analysis of the various expenses contributing to costs. The following list of suggested inquiries into efficiency of the various sections are representative:—

(1) Tons of castings per £ of wages paid—general.
(2) Tons of castings per £ of wages paid—classified.
(3) Tons of castings per man-hour—general.
(4) Tons of castings per man-hour—classified.
(5) Percentage indirect to direct wages.
(6) Metal-mixture cost per ton melted.
(7) Metal cost per ton of castings—general.
(8) Metal cost per ton of castings—classified.
(9) Percentage loss in melting and handling.
(10) Ratio of fuel to metal melted.
(11) Fuel cost per ton of metal melted.
(12) Fuel cost per ton of good castings.
(13) Percentage of wasters in foundry.
(14) Percentage of machine-shop foundry waste.
(15) Total percentage waste attributable to foundry.
(16) Cost per ton of sands and refractories.
(17) Cost per ton of general supplies other than above (16).

Estimating

When estimating for casting costs the general rule is to base the calculation on the known costs of similar castings made previously, along with adjustments due to alteration in production methods and changes in material costs in the meantime. But with medium and large castings of a strictly jobbing nature, especially if new to the particular foundry, there will be a greater call on the general experience of the foundry staff.

The general basis for estimating the probable costs of a casting should be considered in the light of the following questions:—

(1) What class of casting is required?
(2) Is the quality of metal and machined finish of the first consideration?
(3) Is the general and superficial outer form and finish the most important requirement?
(4) Is price the all-important consideration?
(5) What is the delivery time and destination of the castings?
(6) What is the condition and style of the patternwork?
(7) What are the facilities of the foundry to produce the castings?
(8) In view of the foregoing questions, are there special risks in making the particular casting?

The consumer of castings will, of course, decide that he requires, in each class of casting, quality of metal and excellence of form and finish, with the shortest delivery and at the lowest price! Specifications carrying thoughtless and unreasonable requirements and delivery times may increase considerably the cost of a casting.

Influence of Section on Costs

It is often difficult to convince a consumer of castings that, whilst two castings may be of similar design, one may be of thinner section than the other, and will, consequently, be dearer to produce. Not only will the ratio of increase in cost follow progressively a reduction in section, but a point is reached when a continued thinning will bring along greater risks of defective castings. It is certain that to locate cores in a 2-in. sectioned casting mould will be easy compared with the location of cores in a ½-in. or ¼-in. sectioned casting mould.

Fig. 1 outlines, graphically, the comparative effect of section and mass on the cost of castings. The price figures shown are for direct labour-moulding and coremaking—only. On this basis figure, the final estimate is arrived at by allocating a percentage overhead charge for unidentifiable labour and general charges along with cost of metal ascertained from previous results over a reasonable period during which the foundry has been economically employed.

No matter what class of casting is to be produced the comparative costs will be reasonably similar to those indicated in the graph, Fig. 1, where the cost of moulding and coremaking

(*Concluded on page* 340)

an Output of 1,000 *tons, over a Period of Five Weeks.*

ed and establishment charges.			Unit-tons.	Standing and general charges.				Unit-tons.	Grand totals.	
Plant.	Buildings, etc.	Total.	Expense per unit.	Foundry office.	Head office.	Miscellaneous, contingency, commercial.	Total.	Expense per unit.	Total.	Expense per unit.
£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
50 0 0	450 0 0	500 0 0	0 10 0	250 0 0	1,500 0 0	1,000 0 0	2,750 0 0	2 15 0	8,577 10 0	8 11 6
50 0 0	25 0 0	75 0 0	0 1 6	100 0 0	500 0 0	400 0 0	1,000 0 0	1 0 0	3,190 0 0	3 3 10
50 0 0	25 0 0	75 0 0	0 1 6	75 0 0	375 0 0	125 0 0	575 0 0	0 11 6	1,480 0 0	1 9 7
50 0 0	25 0 0	75 0 0	0 1 6	75 0 0	375 0 0	125 0 0	575 0 0	0 11 6	5,670 0 0	5 13 5
25 0 0	25 0 0	50 0 0	0 1 0	37 10 0	250 0 0	75 0 0	362 10 0	0 7 3	469 10 0	9 5
20 0 0	5 0 0	25 0 0	0 0 6	12 10 0	12 10 0	12 10 0	37 10 0	0 0 9	102 10 0	2 1
50 0 0	25 0 0	75 0 0	0 1 6	250 0 0	250 0 0	250 0 0	750 0 0	0 15 0	1,110 0 0	1 2 2
295 0 0	580 0 0	875 0 0	0 17 6	800 0 0	3,262 10 0	1,987 10 0	6,050 0 0	6 1 0	20,599 10 0	20 12 0 per ton.

The Second Welding Report

The Institution of Mechanical Engineers, at a meeting held last Friday, discussed the Second Report of the Welding Research Committee. An introduction to the Report states that a considerable number of welds have been prepared by firms carrying out welding operations, to specifications drawn up by the Committee. Tests of these have been carried out in the condition as welded and after two heat-treatments. A very considerable number of the welds were submitted to X-ray examination. The following physical tests have been carried out on specimens prepared from these welded plates:—(1) Tensile tests at various temperatures, including long-time creep tests; (2) repeated stress tests, on a special machine designed to test welded plates at either ordinary or high temperatures, as well as on the more usual type of repeated stress machines; (3) impact tests at various temperatures, and impact tests at the normal temperature after prolonged heating at a specified temperature; (4) bend tests in which the percentage elongation of the weld metal, and the angle of bend of the weld and the plates welded, have been measured under certain loads and before cracks appeared; (5) investigation of hardness distributions through the weld and in the plate adjoining the weld; and (6) corrosion tests on various types of welds and on plate specimens.

Analyses of certain electrodes, and the welds produced from these electrodes, have been made. Photomicrographs and macrophotographs of welds have been prepared, and these have been compared with the X-ray photographs. An attempt has also been made to relate the physical properties to the X-ray and photomicrographs.

A sub-committee has given very serious consideration to the initial stresses in welds, and a good deal of work has been done in an attempt to develop a non-destructive test which would indicate the magnitude and distribution of initial stresses in the welds. The Committee has also arranged for the carrying out of repeated pressure tests on large-size welded drums. These tests have not yet been completed, and therefore cannot be incorporated in the report.

The following conclusions have been drawn:—(1) The analyses of weld metal show that the carbon and manganese contents of the metal in the weld may differ very considerably from those in the electrode. (2) If a sufficient amount of top metal is laid over the "V" of weld metal connecting two plates, the metal within the "V" may become normalised to an appreciable depth and a large portion of the weld may therefore have a normal microstructure. (3) Small cavities and inclusions may be found in all except the best welds, and these may have an important effect upon the fatigue range of the weld. X-ray examinations of the weld can show the location, size, number of cavities and inclusions. The photomicrographs shown in this part of the Report, and particularly in the metallurgical report given in an appendix, are confirmed by X-ray photographs. (4) The resistance to creep of weld metal is about the same as that of very mild steels. At temperatures above 300 deg. C. the phenomenon of creep may become of importance. At boiler temperatures, as distinct from superheat temperatures, no serious difficulty due to creep need be apprehended at the normal working stresses of boilers. (5) The results of the impact tests seem to show that at any temperature at which boilers containing weld metal of the particular qualities tested may be working, there is no fear of that type of brittleness which impact tests indicate causing failure. At temperatures below freezing point there is very little difference between the results from welds and from mild steel plates. (6) The investigation indicates the desirability of a bend test in which, in assessing ductility of the weld metal, the percentage elongation of the weld metal at the surface of the "V" is measured. (7) Repeated stress tests on various types of machines show definitely that the welds examined have fatigue ranges less than the range for unpierced steel plates of the same tensile strength as the weld. (8) The large number of welds that have been examined, some of which experiments are detailed in this report, show clearly that it is important to select a suitable type of electrode and welding technique for the boiler work in order that cavities and inclusions should be reduced to a minimum. Further, definite control in the method of welding is of fundamental importance, particularly in order to avoid imperfect fusion. (9) The tests that have been carried out on a number of welds indicate that in the neighbourhood of welds corrosion in a fluid of the type given in another appendix is not likely to be more serious than the corrosion of the plate.

Efficiency and Costs in the Foundry

(*Concluded from page* 339)

labour is based on an average-cored good-class casting. It will be noted that for a 2-in. general sectioned casting the cost will be approximately 2s. 6d. per cwt., rising to 22s. per cwt. with the ¼-in. sectioned casting. Generally, the incidence of oncost charges follow faithfully in proportion to the metal section until very thin castings are required, when the oncosts will be greater. An acceleration in the ratio of increase in costs according to section is necessary when the metal section reaches ⅝ in. thickness. An extra 2½ per cent. is added for the ⅝ in. section, 5 per cent. for the ½ in., 7½ per cent. for the ⅜ in. section, and 10 per cent. for the ¼ in. section. This special increase is necessary due to the extra care needed to produce lighter castings.

To produce the same weight of castings with a ¼-in. section as can be obtained from the 2-in. section casting, it will be necessary for the foundry to produce eight times the number of castings. The cost of metal may also be dearer per cwt. in the thin-sectioned castings, due to the necessity of introducing a more expensive metal suitable to a thin casting and to the percentage amount of head metal returned after pouring.

It is not difficult when estimating, to ascertain the probable cost of a casting if the various aspects outlined in these notes are accounted for. To analyse the costs consequent on the various expenses is very informative, and will serve to arm the foundry authorities with the incidence of overhead charges when quoting for outside jobbing castings and thereby eliminate unremunerative work from finding a place in the foundry. If the foundry is attached to an engineering establishment, then the company will also know more clearly the comparative costs of different classes and types of castings which they use to fabricate a machine or engine.

Individual-casting costs for most outside jobbing work will be necessary, but such detailed costing will be unnecessarily expensive for castings for one's own consumption, if carried to its logical conclusion, to include the thousand-and-one items in any foundry.

Sir Frank Smith will for the time being be at the head of the National Physical Laboratory. An official announcement states that the Lord President of the Council has decided that, pending the appointment of a successor to the late Sir Joseph Petavel, the office of Director of the Laboratory shall be held by Sir Frank Smith, who is the Secretary of the Department of Scientific and Industrial Research.

Sheffield Foundrymen's Election of New Officers

The last meeting of the 1935-36 session of the Sheffield Branch of the Institute of British Foundrymen was held at Sheffield on April 17; the Branch-President (Mr. A. Whiteley) was in the chair. Officers for the ensuing session were elected.

Mr. Whiteley proposed the election of Mr. J. Roxburgh, foundry manager of Davy Bros., Limited, Sheffield, as President. He remarked that Mr. Roxburgh had during the last two years held the offices of Junior Vice-President and Senior Vice-President respectively. He had also served the Branch well for a number of years as a member of Council, and had given them numerous Papers. Mr. J. B. Allan, in seconding, described Mr. Roxburgh as a tower of strength to the Branch. The resolution was carried.

Mr. Roxburgh expressed appreciation of the honour conferred upon him, and assured the meeting that he would do everything in his power to uphold the tradition of the office.

On the motion of Mr. Roxburgh, seconded by Mr. Whiteley, Mr. J. B. Allan, foundry general manager of the Staveley Coal & Iron Company, Limited, was elected Senior Vice-President.

Mr. R. C. Tucker proposed that Prof. J. H. Andrew, of the University of Sheffield, be elected Junior Vice-President. In making such an appointment, he said, he did not think they would be particularly honouring Prof. Andrew, but rather that Prof. Andrew would be honouring the Branch. By his interest in the British Foundry School and the Foundry Course at the University, Prof. Andrew was already doing a very great work for the Institute. Mr. F. E. Steele seconded, and the resolution was carried.

Mr. F. E. Steele was re-elected a member of the Council, to serve three years. Mr. F. Whitehouse was elected to succeed Mr. J. Emmott, who had expressed a wish to resign, and Mr. H. T. Winterton in place of Prof. Andrew.

On the motion of Mr. Roxburgh, seconded by Mr. Allan, Mr. T. R. Walker was re-elected secretary and treasurer. High appreciation of Mr. Walker's work was voiced by the speakers. Mr. Whiteley said no Branch could possibly have a better secretary. The whole-hearted way in which he did his work left him (the speaker) spellbound with admiration.

In reply, Mr. Walker said he had done his best for the Branch, and would continue to do so. He hoped the members would give him all the assistance they could, particularly with regard to methods for increasing the membership and the attendance at the meetings, and also with regard to subjects for Papers and prospective authors, in order that the services of the Branch might be made more efficient.

The results of other elections were as follow:—Delegates to Technical Committee, Messrs. C. D. Pollard and T. R. Walker; delegates to General Council, Messrs. A. Whiteley and C. D. Pollard; auditors, Messrs. G. L. Oxley and S. Leetch.

Ferro-alloys in Canada

St. Lawrence Alloys, Limited, of Beauharnois, Quebec, is developing plans for the production of ferro-alloys. The company has been organised under a Dominion charter as a private corporation with shares held by Canadian, British and United States interests. The company proposes to produce all grades of ferro-silicon from 45 per cent. up; ferro-manganese both high and low carbon grades; and silico-manganese. The company is also planning the production of other metals, particularly beryllium and its alloys. It is stated that 80 per cent. of the production of ferro-silicon, ferro-manganese and silico-manganese will be shipped to Great Britain and the British Dominions.

Sand- and Shot-Blasting and Silicosis

A BREEZY SHEFFIELD DISCUSSION

When Mr. Bradshaw lectured on "Sand- and Shot-Blasting"* to the Sheffield Branch of the Institute of British Foundrymen he found his audience in an argumentative mood. The discussion was opened by the Chairman (Mr. Arthur Whiteley), who said he had listened to the lecture with considerable interest. It seemed to him that the lecturer had sounded the death knell of sand as a blasting medium, but sand merchants would not object if steel shot was helping to increase the efficiency of foundries and lengthen the life of foundrymen. The refractories industry was well aware of the dread results of silicosis. In the production of ganister and silica bricks, he thought that particular disease was probably more rampant than in any other branch of industry.

It had been of considerable interest to him to listen to Mr. Bradshaw and to hear his arguments in favour of the use of steel shot. He was especially interested in the references to angular steel shot. Personally, he had always been under the impression that steel shot was spherical, and the angular grain of natural sand had been one of the arguments in favour of sand. He was a little disappointed at not having heard how steel shot was made, as he had hoped to have seen some illustrations of the process of manufacture. Perhaps that was a subject that he ought not to mention, but it occurred to him that it might have interested the members of the Sheffield Branch.

Iron Oxide and Silicosis

Mr. R. C. Tucker said silicosis was certainly caused by sand, but it could also be caused by iron oxide. It was very prevalent among the hematite miners in Cumberland, and he often felt that if rusty material was sand-blasted there was a danger, even though they were using clean steel shot, of fine iron-oxide dust being present, and he wondered whether that was perhaps an argument in favour of the older method of pickling castings or rusty materials to remove the scale.

With regard to the loss of weight of abrasive, Mr. Bradshaw had stated that Leighton Buzzard sand lost 10 per cent. of its weight at 15 to 20 lbs. pressure, whereas steel shot lost a very much smaller proportion of its weight at the same pressure. Mr. Bradshaw also stated, however, that steel shot was always used at greater pressure, so perhaps it would be a fairer comparison to give the loss of weight at the working pressure. He (Mr. Tucker) wondered if Mr. Bradshaw had any information on that point. He should think that the majority of those present, as iron-founders, were interested in sand blasting simply as a means of cleaning castings, and he always felt that they could only clean simple shapes economically by sand blasting. He remembered a case where he had some filter plates which had little sand cores in the corners, which were the cause of much trouble. He could not imagine a sand-blast nozzle getting into those little cores, and he thought that pickling would be the solution of that problem, rather than sand blasting. He would like Mr. Bradshaw's comments on the question of what castings could be cleaned economically by the use of sand blasting. They all knew that plate work, or simple work, could be cleaned very efficiently and very cheaply by this method, but would the lecturer tell them how a fairly complicated cylinder head, say, could be cleaned by sand blasting.

Mr. Bradshaw, referring to Mr. Tucker's remarks on hematite mining, said it was the "free" silica, really, that was the cause of silicosis. In the glass industry, for instance, there was a big risk of contracting silicosis, but he believed that was due to the materials. Once the silica had got into combination with other elements, it formed compounds which were not so dangerous.

Mr. Tucker agreed, and said quite a lot of work had been done on the question of stone dusting in mines, and that silicates were found to be quite harmless. But it was a fact that other materials besides true silica could give silicosis.

Mr. Bradshaw said he agreed—for instance, asbestos could cause this disease, but with regard to ferric oxide he should be sceptical, since iron salts were soluble in the human system.

Mr. Tucker: But when they are deposited in the lungs, they do actually grow.

Mr. J. E. Hurst asked Mr. Tucker whether there was any difference in the behaviour of the respective oxides of iron.

Mr. Tucker: That has not been proved yet.

Mr. Hurst: There is no evidence with regard to magnetic oxide?

Mr. Tucker: No.

Mr. Hurst: But there is with regard to Fe_2O_3?

Mr. Tucker replied that the hematite miners which he had mentioned were only one case.

Mr. Hurst thought that was important, because the majority of the oxide on castings that one had to contend with was the magnetic oxide.

Mr. Tucker: Yes, unless the castings were rusty.

Mr. Hurst said that a good deal of publicity had been given to this question of silicosis, and it was of some importance not to create any scare about it.

Mr. Tucker: There is no evidence yet of a particular form of iron oxide being more dangerous than the others, but the question is still in its infancy. That it is some form of iron oxide, however, is fairly certain.

Life of Sand and Shot

Mr. Bradshaw, replying to Mr. Tucker's question with regard to loss of weight, said he took it that the gentleman was referring to the information which he (the lecturer) published, and which was based on Neville's work of some five or six years ago. Neville conducted experiments at a pressure of about 15 lbs., with the results that were given in the Paper. He (the speaker) had not any actual data on that. The only information he could give was that chilled steel abrasive would last approximately 15 times as long as sand under the same conditions. Of course, Mr. Tucker would realise that the higher pressure was necessary to carry the heavier material. With regard to the economical removal of cores, what was the size of the cores?

Mr. Tucker: Only about $\frac{3}{8}$ in.

Mr. Bradshaw, agreeing, said if it were $\frac{3}{8}$ in., it would probably be quicker to get it out with a file, or something of that sort. Cylinder blocks were being cleaned successfully by the sand blasting process.

Mr. T. R. Walker said that they had heard a lot that evening about silicosis. He thought that in this respect Mr. Bradshaw had perhaps rather overstated the case for steel shot, and he did not think that Mr. Bradshaw would claim that a foundry using steel shot instead of sand for blasting would be exempt from the provisions of the Silicosis Act. After all, most castings were made in sand moulds and any process likely to produce dust, whether from the surface of the casting or from the blasting material with a silica content of 80 per cent. or over, came under the provisions of the Act. He was quite sure that all the best foundries recognised the danger of silicosis and in those foundries, owing to the precautions taken by the management, there were very few cases of silicosis whether the foundries were using sand or shot blasting.

He was interested in Mr. Bradshaw's remarks about the lowered efficiency of nozzles as they enlarged with wear, but he took it that Mr. Bradshaw's remarks applied principally to cases where the air compressor was of insufficient capacity to maintain the pressure at its proper value when the nozzle became enlarged. If it maintained the pressure it seemed to him that any increase in the size of the nozzle, according to what Mr. Bradshaw had said, meant an increased rapidity in the shot blasting until, of course, the end of the nozzles became of a definite barrel shape, when the efficiency would fall off owing to the large increase in area covered by the shot from the nozzles. He was also interested in Mr. Bradshaw's remarks about the guarantee given with nozzles lined with Norbide. In view of the differences in the guaranteed hours given for alumina, silica sand and chilled steel shot as abrasives, it seemed to him that aluminium oxide abrasives were apparently the ones which removed material most quickly. Could the author give any information regarding the efficiency of aluminium oxide abrasives when used for cleaning castings?

Mr. Bradshaw, replying to Mr. Walker's question as to exemption from the Silicosis Regulations when cleaning castings, said the use of a chilled steel abrasive was advocated and recommended by all His Majesty's Factory Inspectors. It was claimed that the sand that was fused on the surface of a casting was really a silicate, and as such, when working, was less dangerous than the actual free silica. With regard to nozzles, it was really a question of whether one could maintain the pressure, and if one's apparatus was sufficient to maintain a constant pressure irrespective of the diameter of the nozzle, then, of course, one could efficiently sand blast. But very often the compressor was not capable of that, and, as the nozzle wore, so the pressure decreased. With some of the older plants, at any rate, that happened. With regard to the query as to aluminium oxide, he regretted that he had no available information on that point.

Mr. Tucker said aluminium oxide was too hard, and even scratched cast iron very badly.

Mr. Hurst said he should imagine that much depended on the actual cleaning operation that one was engaged upon. It was not necessarily the hardest material that was the best from a cleaning point of view. The actual energy content of the individual blows struck by the particles of material was equally important in some cases. If they had to raise the velocity of aluminium oxide particles to give a momentum equivalent to iron particles, it was quite possible that the cost of doing that might be out of proportion.

Mr. Walker: Surely the specific gravity of aluminium oxide is not very different from that of silica.

Mr. Hurst: But it is very different from that of the metallic chilled steel abrasives.

Mr. Walker: But we have in the Paper the ratios of the pressures required for use with silica sand and with chilled shot, so that it ought to be easy to obtain the pressure necessary for use with aluminium oxide abrasives.

Mr. Hurst: Yes.

Mr. Tucker presumed that aluminium oxide would not cause silicosis.

Mr. Walker: Certainly, but it might cause a similar disease, called by another name.

Mr. Tucker: I rather think it is the other way round, that a lot of diseases are incorrectly called silicosis.

Mr. Walker: Oh, certainly.

Mr. Tucker: Do you claim for the steel shot process that the cleaning costs per ton of castings are less than with sand?

Mr. Bradshaw said he claimed that the cleaning cost per ton, cleaned with chilled steel abrasive, was less than with the sand, but he was basing that on the fact that a quicker output was obtained from the machines. The abrasive

* See Foundry Trade Journal, March 12, 1936, p. 205.

is quicker, and there was a longer life from the abrasive, and, from a given plant, a bigger output was obtained.

Mr. Tucker: But supposing a sand plant was sufficient to deal with the output of your foundry, would it pay you to go over to steel shot?

Mr. Bradshaw: Yes, from the point of view of longer life of the abrasive medium.

Mr. Tucker: Does that balance the initial cost?

Mr. Bradshaw: Yes, certainly; in fact, there is a big margin.

Airless Machines

Mr. C. H. Sanders asked which was the better machine for cleaning castings, the centrifugal or the air machine?

Mr. Bradshaw said it was really a question of economics, and the amount of work they had to do. If they had a large amount of work of a fairly small type coming through, then a centrifugal machine was better from that point of view, but if the work was of the larger type, of course, they had to go back to the pneumatic or blasting machine.

Mr. Walker asked what happened to the angular shot when it wore. Did it wear round or angular?

Mr. Bradshaw said that if it was a good sample, it should not wear round. It would break away and disintegrate, and keep in use, maintaining its angular character until it was so small that it passed away through the exhaust fan.

Mr. Walker: In that case, then, it resembles the sand.

Mr. Bradshaw: Yes.

Mr. Walker: But it takes longer to do it?

Mr. Bradshaw: Oh, yes.

Mr. Walker said he did not suggest that the shot would round over but thought that the projecting edges would get worn down a bit. Even a diamond point would wear down with constant use but it would not round over.

Mr. Tucker said wind borne sand was round. Desert sands, and sea sands, were round, merely by attrition. It was a question of velocity of impact. He thought the impact value of a hard steel was very low. If they had an angular particle hitting a hard casting surface with a certain momentum, they might exceed, with the very fine, very small area of attack, the impact value of that steel, and they might break pieces off. It was very difficult sometimes to imagine the force that came into play over such a small area. A few weeks ago he heard a Paper which described a very small spindle. This only weighed about five grammes, and it was on such a fine steel point that the pressure was 100 lbs. per sq. in. on the point, and they got a peculiar form of corrosion there, due to the excessive pressure.

Mr. Walker, reverting to the question of breakage, asked if Mr. Bradshaw did not claim in his Paper as one of the advantages of chilled shot the fact that it had no cleavage planes, and therefore would not break?

Mr. Bradshaw said he thought Mr. Walker would agree that, although there were no cleavage planes, it was a brittle material, and as such it should break rather than round over. If the material was of a soft character, then of course there would be a tendency for it, during wear, to take on a round shape.

Mr. Sanders asked what kind of nozzle was used for the centrifugal machine, as against the ordinary machine. Was it a wide or a round nozzle?

Mr. Bradshaw said there was actually no nozzle in the sense in which they understood it on the ordinary sand blast plant. The material dropped down from a hopper on to a revolving disc, which forced it by directing it into the machine through a kind of rectangular opening.

Vote of Thanks

Mr. Hurst said there were two types of centrifugal machine at the moment—one which was very much like the Sandslinger with the single blade, and the other which had an impeller like the centrifugal pump.

Going on to propose a vote of thanks to the lecturer, Mr. Hurst said the members would have gathered that Mr. Bradshaw was a colleague of his. He could assure them that Mr. Bradshaw had devoted a good deal of time to the study of questions regarding sand blasting, and the efficient use of materials for the process. He supposed it was true to say that sand blasting, as a method of cleaning castings, was a very old method, but it was only of comparatively recent years that it had been thoroughly studied. It was probably true to say that a good deal of this attention had arisen owing to questions concerning the disease of silicosis. Whilst it might be admitted that there was a good deal yet to be learned about silicosis, Government officials did apparently take a serious view of the disease, and in so far as sand blasting was concerned, they had begun to give it their attention and to consider the question of the materials for actual use in the sand blasting machine. Whatever was said about those materials, there was one thing that could be said about chilled steel abrasives, which was that they were intrinsically free from silica, and from that point of view they might have some effect in minimising the tendency to silicosis. One object in giving a lecture was to endeavour to impart as much information to the members as the lecturer could, and the other was to derive as much information as he could from them; and he felt certain that Mr. Bradshaw, like himself, would have been very glad to have heard what some of their steel foundry friends had had to say about the use of sand blasting, particularly about using shot as a method of cleaning steel castings. However, he was certain that Mr. Bradshaw would be satisfied with the rather bright discussion, and that it would repay him for his time and trouble in preparing the Paper.

Mr. A. Carr, in seconding, said they had a good deal to thank the lecturer for. Mr. Whiteley had suggested that Mr. Bradshaw might tell them how steel shot was made. He was afraid that he (the speaker) could not throw any light upon it. The lecture had been very interesting. He agreed with Mr. Hurst that it was rather disappointing that more members from the steel-foundries in Sheffield had not been present, because he thought their attendance would have added to the general interest and would also have been more gratifying to the lecturer.

The Chairman, in supporting, said perhaps they would hear something about how steel abrasives were made some other time.

The resolution was carried.

Mr. Bradshaw, in reply, said it was always a pleasure to come to Sheffield to give a Paper. That was the third time he had been there and he always seemed to get a warm reception and a lively discussion, which repaid a man for preparing a Paper, because it showed that some of the remarks had been useful. With regard to Mr. Tucker's remark on sea sand, he would point out that the rounded particles were caused primarily by a rolling action. It was not impact, but was simply a case of revolving one over the other, whereas with a sand blast they had a decided impact and blow, and that, of couse, produced the differences in the produet.

(*Continued from next column.*)

cupola in daily blast, and in addition there will be a great saving in patching material. It must not be overlooked that cupolas often change their area in the melting zone, and it is not always wise to patch the melting zone flush with the bore of the cupola, but rather to conform with the shape formed by its own working.

(*To be continued*)

Students' Corner

SECOND SERIES

Cupola Practice—*(continued)*

Q. 6.—What is the amount of fuel required per ton of iron melted?

A.—Before answering this question there are certain factors, such as the composition and cleanliness of the pig-iron and scrap, that must not be overlooked. To mention two extreme instances: if the composition of the iron shows a high phosphorus content, say 1.5 per cent., a less quantity of coke per ton of iron melted can be used than with an iron containing less than 0.5 per cent. of phosphorus. The melting point of phosphorus is 44 deg. C., and the fact that a high phosphorus content increases the fluidity of the iron, and lowers its melting point, is exemplified in everyday practice. With such phosphoric irons, other conditions being favourable for continuous melting (*i.e.*, daily running), 1½ to 1¾ cwts. of good cupola coke per ton of iron will give a hot fluid iron.

If an iron is used containing, say, carbon 3 per cent., silicon and phosphorus under 0.5 per cent., it would have a high initial melting point, especially if these limits are adhered to by means of adding steel scrap; it would also have a narrow range of fluidity. Hence, with such metal charges, the fuel required to impart sufficient superheat would not be less than 2 to 2½ cwts. of good cupola coke.

In neither of the instances described is the bed charge of coke included, since it is the same for a 10-ton melt as it is for a 40-ton melt.

Q. 7.—What should be the life of the lining of a cupola in daily blast?

A.—The life of a cupola lining, especially around about the melting zone, largely depends upon general treatment, and the quality of material used. Where fairly large daily melts are customary, it is an economical proposition to install two cupolas and run each on alternate days. This allows time for each cupola to be properly patched or repaired after each blow. This may appear unnecessary, but its value will be appreciated if the cost of the wasted material used for daily patching and trouble arising from insufficient drying be taken into consideration.

Most of the damage is done in the region of the tuyeres and the melting zone. Damage is also caused by allowing the blast to remain on after the iron is melted. This apparently results from the presence in that locality of the cupola of gases that violently attack the lining, even when of highly refractory material, presumably due to the absence of stock to absorb the heat.

When patching a cupola lining, it is wrong to fill in or daub worn places with a large thickness of ganister or fireclay. It is far better to use only sufficient clay to ensure that the pieces of brick used for filling in will adhere to the places required to be patched. If, in the absence of split bricks, the patching is done by a highly refractory material, then it should be applied sparingly.

When the repairing is not carefully done and dried, the patching becomes mixed up with the charges by being dislodged when the blast is put on for the blow. Also, it is unwise to do heavy patching when the cupola is very warm, since steam from the moisture in the material gathers behind the patching and forces it out. A gentle fire should first be put into the cupola to stiffen and reduce the moisture in the patching. When charging the cupola, some care should be taken not to disturb the repaired places.

When two cupolas are alternately in daily blast, with ordinary care the life of each of them will be more than double the life of a single

(*Continued in previous column.*)

Contraction*

By W. MACHIN and M. OLDHAM

It has frequently occurred to the authors that contraction, with its associated problems, is deserving of closer attention than is devoted to it. The problems referred to in this Paper are those experienced not only in the foundry, as manifested by hot tears and cracks, but also in the machine shops, to which all engineering castings are ultimately delivered for machining.

One has frequently heard the statement that nearly all castings contain contraction faults, *i.e.*, cracks, stresses or strains, to some degree. The statement may be true in many instances where care has not been taken by the maker

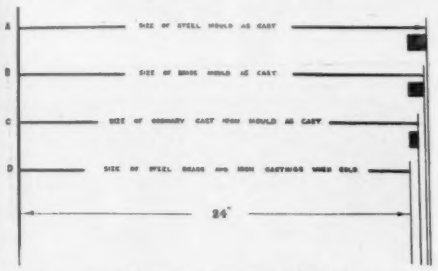


Fig. 1.—Relative Sizes of Moulds and Casting.

to prevent them, as such faults are known to be caused by many of the operations associated with the varied stages of manufacture.

All cast metals are subject, in varying degree, to the laws governing expansion and contraction, and it is disturbing to note how little attention seems to have been devoted to this subject by research workers on foundry operations. It is no uncommon experience, for example, for some castings that have been machined to be considerably different in dimensions from drawing sizes, the discrepancies occurring sometimes only after a few days standing. Such results arise from release, to some extent, by machining operations, of previously "locked up" stresses, and in view of the modern demand for fine dimensional accuracy such stresses may be the cause of very serious trouble.

It was decided, therefore, that consideration could usefully be given to a few of the factors involved which might be of general interest to foundry workers, metallurgists and engineers.

All phases of casting production to which the founder gives his attention lead up to that critical stage where contraction takes place from the plastic condition to the solid at atmospheric temperature. Castings of iregular section, such as handwheels, for example, which are designed with thin spokes and thick rims, may fly in two or more parts. More often than not, breakages of this kind are the direct result of sudden release of high stresses produced during contraction. A breakage of this kind may be brought about by so commonplace an incident as the tap of a small hammer.

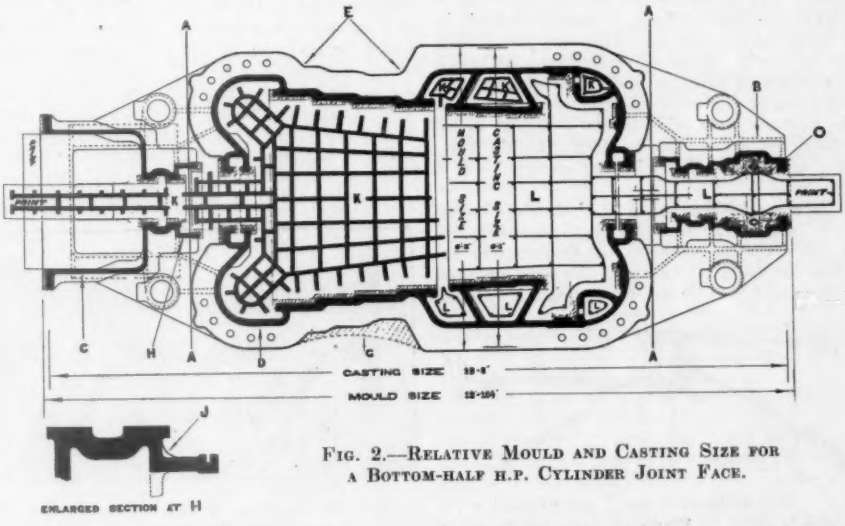


Fig. 2.—Relative Mould and Casting Size for a Bottom-half H.P. Cylinder Joint Face.

Cause of Faults

Mainly, the causes of contraction faults which occur during the change from the plastic to the cold condition are: irregular thickness of design, method of construction of mould and core, temperature of mould, uneven cooling, or cooling of the casting too quickly. Some of these causes are also associated with other types of defects in castings, but it must be appreciated that the authors in this Paper are dealing only with those caused by contraction.

All workmen and supervisors in the foundry have as their sole objective the production of a shape in metal, to a specified design, which it would be almost impossible to machine or carve out of the solid block, even if it were economical to do so. A bulk of metal cast into a mould of the required interior shape is nothing more than a useless molten mass, and even when it is passing through the plastic stage it contains none of the attributes for which it is useful when cold.

The casting must cool gradually to atmospheric temperature, and during this cooling period complicated reactions take place and the points mentioned require the careful study and attention of all associated with production.

In Fig. 1 is shown a diagram relating to the dimensions of moulds for a casting 24 in. long, just at the point of solidification, and also of the castings after they have cooled to atmospheric temperature. It will be seen that the expansion

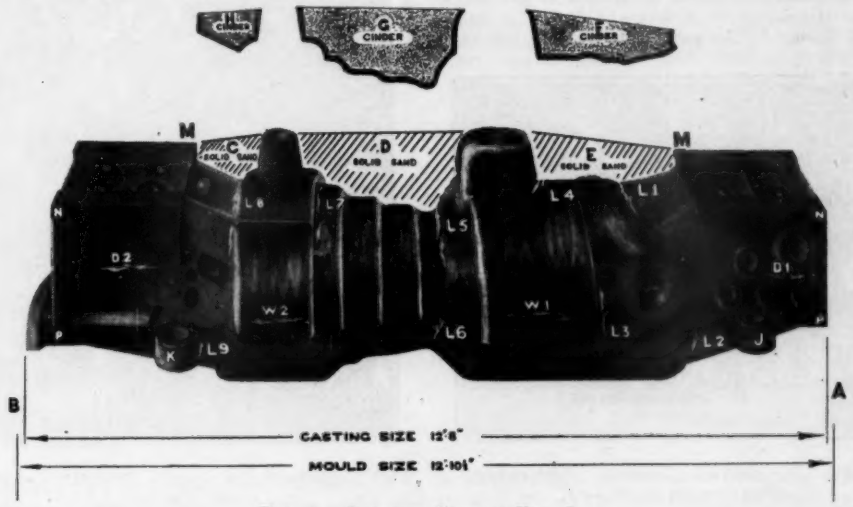


Fig. 3.—Opposite Side to Fig. 2.

of each of the metals consequent upon the elevated temperature during melting has made it necessary to make patterns larger than the actual finished article, so that the mould or moulds made from them will produce a casting accurate to the designed size when cold. The size of a mould for a piece of metal 24 in. long to receive the expanded metal in liquid state is as shown at A, B, C, and the same metals when in the cold state have contracted to the bottom line "D."

It is not intended to deal in this Paper with the metallurgical changes that take place during the liquid to plastic stage of the metal, nor is it intended to deal with the question of shrinkage between the liquid and plastic condition. These two subjects are variable according to the metal composition, and each of them, as is well known, is of very great importance regarding other problems connected with castings manufacture. They are, however, not actually considered the cause of such serious defects in a casting as is the period of movement from the plastic to the solid condition.

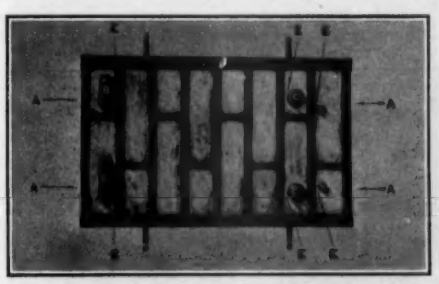


Fig. 4.—Moulding Box Design Related to Contraction.

The line on the diagram at "A" is the widest one, and the metal in this instance is for cast steel, "B" is for brass, and that shown at "C" is for cast iron. The first gives the foundryman most trouble on account of the short freezing range, and the fact that cast steel

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. Daniel Sharpe presiding.

travels the greatest distance in contracting to the "D" line. This diagram was drawn with the intention of showing in the simplest possible manner the extent of movement of the metal in a mould. This movement is a fundamental property of the materials, and if prevented or retarded in any way, trouble in the form of hot tears or invisible trouble in the form of strains occur.

Cast Steel

The type of defect which is considered by all inspection authorities as serious (and rightly so) is what is described by the foundryman as a "hot tear." In order to define some of the causes of this, reference is made to Fig. 2, which shows the design of a bottom-half h.p. cylinder-joint face. This particular design has been

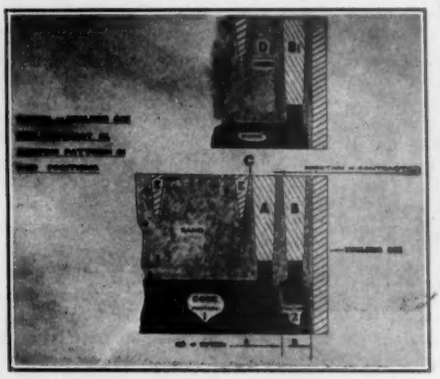


Fig. 5.—Section through Moulding Box shown in Fig. 4.

chosen because of the complicated difficulties associated with contraction during its manufacture. Frequent reference, therefore, will be made to it to illustrate the various points connected with this subject.

The length of this casting is 12 ft. 8 in., but the pattern size from which it was produced was 12 ft. 10½ in. The movement of contraction in this case, therefore, is 2½ in., *i.e.*, the cold casting was that amount shorter than the mould from which it was cast.

The design of this component is not ideal from a foundryman's point of view, and, although many suggestions have been put forward by him for improvement, the designer has not yet found it possible to embody the suggested alterations, so the foundryman must face the risk and do his utmost during manufacture of mould and core

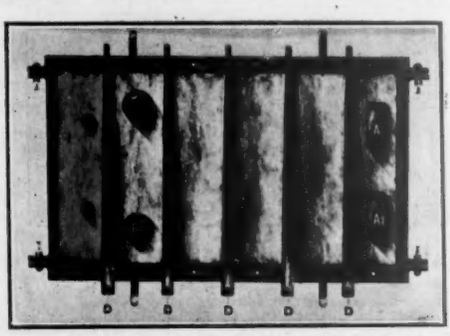


Fig. 6.—Moulding Box Made from Loose Sides without Bars Cast In.

to produce a casting free from hot tears. The contraction problem in this instance would have been simplified considerably by casting the bearing blocks separately and joining them to the body of the cylinder with a joint shown at "A." The movement in the casting would then only have been 1½ in. instead of 2½ in.

In addition, the designer could have helped the foundryman considerably by making the thin walls of metal shown at "B" and "C" equal to the body thickness of the cylinder shown at "D." This alteration would have assisted in keeping the cooling rate of the casting more uniform.

The steelfounder has to commence his study of the method of manufacture by an examination of thicknesses, so that he can make an effort to control the cooling rate. He usually does this

Fig. 7.—Propeller Shaft Bracket Casting after Easing.

by runner and feeder distribution, but it is not intended to enlarge on these subjects now. The cooling of the casting, however, is considered extremely important, in order to obtain, as far as possible, a condition whereby all parts of the casting commence to contract at the same time.

Mould Temperature

The temperature of moulds is another important point, and the hotter these are when cast, the easier they crush when contraction takes place, as in this condition the moulds are weaker. If it were possible to have a mould as high in temperature as the casting metal, one would then obtain a much improved condition, although there would still be some resistance of the sand arising from its lower coefficient of contraction. At the present time, this is not possible, as no refractory materials are available to do this, and the moulds must be heated as much as is possible.

Hot moulds, besides being in themselves easier to crush, also delay contraction, and, owing to the delayed cooling of the metal, are in a better condition for crushing owing to the time afforded for heat conduction from the metal. A further

Fig. 8.—Part Section of a Casting 24 ft. Wide.

advantage obtained here is that the delayed cooling of the metal gives better opportunity for heat distribution through the casting.

Sharp corners and abrupt shapes are also considered a real danger to good results, two of these parts being seen at "E," Fig. 2. These parts of the casting would have facilitated contraction if the designer had made them to the dotted line "G." Then, again, the shape at "H" would have contracted much easier if it had been designed with a curve as seen in the enlarged section view of "J." Designers are therefore counselled to observe that curved shapes—easy curves, of course—are better than abrupt corners, as the latter are a source of real difficulty and anxiety to the foundryman.

Another item which is considered of very great importance is mould and core manufacture; by this reference is made not to the design side, which is in the designer's hands, but to the manipulation and choice of materials. The core for a casting of the type previously described must not be made rigid; if it is, cracks are certain to appear in the casting.

In the making of cores, therefore, the use of cast-iron grids should be eliminated as much as possible. The reproduction shows the grids referred to marked "K," and it will be seen how core irons of this kind can retard contraction. The method of using cast-iron grids is much

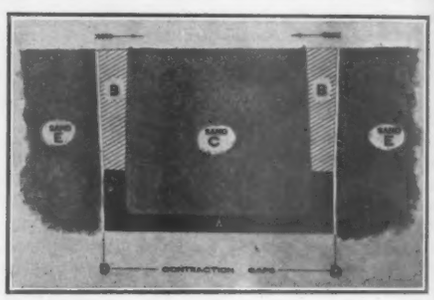


Fig. 9.—Contraction on a Simple Casting.

easier for the coremaker than that of manufacturing the cores with loose irons, as is seen at "L," but the latter is undoubtedly the correct one. The loose iron method is not so rigid, and therefore the core more easily collapses when contraction commences to crush it.

Another important point is in connection with the bearing core shown at "O." This core is better made separately and afterwards fitted round the main core. The reason is to permit it to slide through the main core when contraction commences to take place. If this core were made as part of the main core it would naturally become more resistant, as the core irons in it would be secured in the main core instead of being separate.

Fig. 3 is not a reproduction from an actual casting, but was taken from a freehand drawing of the pattern so that the various points relating to the subject could be conveniently added. It is the opposite side to Fig. 2 and was moulded in the lower half of the mould which was, as

Fig. 10.—Easing Operations on a Flanged Casting.

mentioned, 12 ft. 10½ in. long. The lines marked "A" and "B" again show, as in Fig. 2, the amount of contraction or travel which takes place in the casting during cooling. The portions shown at "C," "D" and "E," are parts of the mould which need to be made weak, *i.e.*, these parts must not be made with solid sand, neither must any reinforcement with heavy iron material be carried out.

The correct way to facilitate the contraction taking place is to build these parts of the mould as shown at "F," "G," and "H," where it will be observed that the sand, shown by a thick line, follows the pattern profile and the centre is filled with cinder material. If this mould were made as shown at "C," "D" and "E," the parts of the casting at "M" would be propped and contraction would be retarded. The result of such a procedure would probably be tears at one or other of the places marked "L" 1-2-3-4-5-6-7-8-9, all these parts show tears which can be caused by retarding longitudinal contraction. The two bosses also marked "J" and "K," could cause the tears "L" 2 and

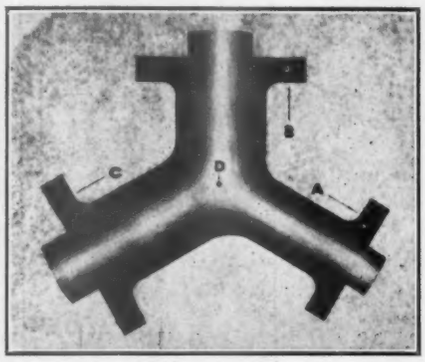


Fig. 11.—Easing Operations on a Flanged Casting.

"L" 9 to occur, if the mould in front of them were too rigidly constructed.

The two tears marked "W" 1 and "W" 2, could occur by the casting being core-bound, *i.e.*, by making the core as shown in Fig. 2, with heavy core grids incorporated instead of loose irons wired together. Also if the core were made with too large a thickness of sand, it would cause hot tears to occur. The two tears shown at "D" 1, and "D" 2, could be caused by up or down contraction, between the points marked "N" and "P." It is, therefore, important to manufacture moulds on flimsy lines, so that they may crush when contraction commences to take place.

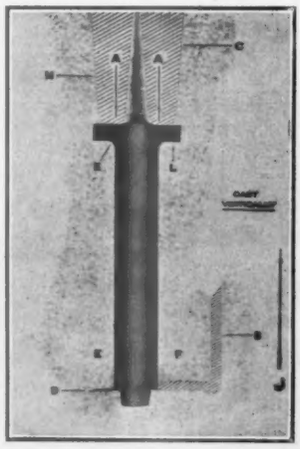


Fig. 14.—Contraction Problem when a Pipe is Cast Vertically.

The foundry operator who has had years of practice and has closely studied his craft knows all the small but important points which lead up to trouble in connection with this subject. A few of these points have already been referred to, but there are many others that can often be noted in practice which militate against the production of good results in the finished article.

It will be appreciated by all that the ability of moulders varies considerably, and whilst it is admitted that some are perhaps 100 per cent. efficient, it may be safe to say that these men are well in the minority. The craft has recently been assisted a great deal in certain instances by moulding machines of various types, but for classes of castings which have to withstand high pressures and temperatures, moulding machines are of little use, as, by this method of moulding, moulds cannot be made sufficiently weak to allow contraction to take place.

The craftsmen required for this type of work are not so proficient or so numerous to-day as they were 20 to 30 years ago. A suggested reason for this is that boys do not appear to be

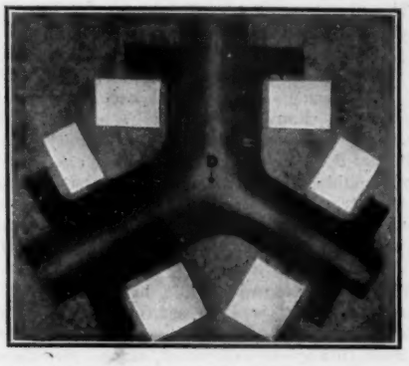


Fig. 12.—Method of Dealing with a Flanged Casting.

coached in the important points as used to be the case. Another point in this connection which is also very noticeable is that teachers of students taking foundry courses are not sufficiently experienced and do not emphasise these important matters.

Consequently, for bringing forward one or two simple examples which combat good results in this connection, the authors hope to be excused. It is known, and will be appreciated, that these examples require the operator's attention at all times, but it has been noticed even at the present time the correct method is not always put into use.

The first example of the methods referred to will be explained by Fig. 4. This view shows a moulding box with bars cast in it, and everyone will no doubt agree that a moulding box of this type is much easier to utilise than is a moulding box without bars.

The contraction on the casting inside this moulding box is in the direction of the arrows as shown at "A." The feeders on the casting are as seen at "B," "B1," "C," "C1," and the runners are at "D" and "D1." The space of sand marked "E," between these feeders and runners and the moulding box bars, will be seen to be too narrow. This condition is considered very bad practice, as, unless the sand is removed before contraction commences, the casting will be anchored at the ends and hot tears will probably be caused.

It will be seen that these feeders and runners should have had more room in front of them, so that a cavity for cinder or other loose material could be placed between them and the bars. It will be appreciated that the sand shown at positions "E" would be extremely difficult to remove unless such precautions were taken.

Fig. 5 is a part sectional view of the moulding box seen in Fig. 4, and will enable a clearer explanation to be made. In Fig. 4 it was shown that the feeder positions were very close to the moulding box bars, and in Fig. 5 there is a clearer view of the point raised. It will be seen in position 1 that without forethought the moulder could have made this item so that feeder "A" would be very close to the bar "E," leaving only the small clearance for sand between "A" and E" shown at "C." The direction of contraction will be noted by the arrow, and the importance of this clearance will be appreciated.

The moulder, with a little forethought, could have altered the position of his pattern to position 2, when he commenced to mould this item. By doing this it will be seen that the feeder position shown at "B" would give more room at "C." This would enable the moulder to carry out the correct method as shown at "B1" and "D," where it will be seen that a cavity of cinders is in front of the feeder in the direction of contraction. The operator must consider these points, especially with dry-sand moulds, otherwise good results cannot be expected.

A type of moulding box which is considered a better one to use for steel casting production

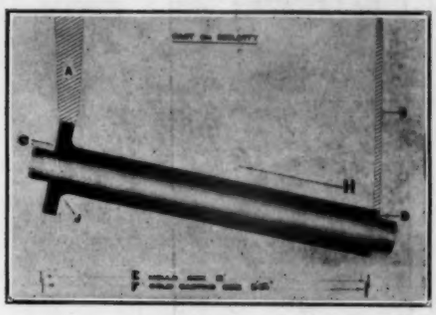


Fig. 13.—Pipe Casting Contraction Problem.

is the one built up with loose sides, and is shown in Fig. 6. The moulding box bars in this instance are all loose and are laid on top of the box. The feeders and runners are shown at "A," "A1," "B," "B1," "C" and "C1." The moulding box bars shown at "D" are all tapered so that they can be easily pulled through lifters or gaggers. A tap from a hammer on the small end allows the operators to pull these bars away very quickly, and liberate castings more quickly from obstructions. The simple points

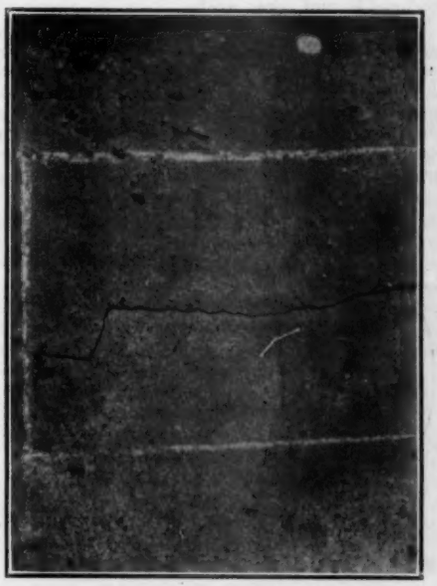


Fig. 15.—Contraction Stress Crack.

raised in connection with the last three figures are the cause of many hot tears and strains in castings.

Easing Castings

Having described the importance of weak mould and core construction so as to permit the full amount of movement to take place another process might be mentioned which assists in this

direction. This process is what is known in practice as easing the casting. This term really signifies stripping away parts of the mould and cores likely to hinder contraction just at the time the metal has become solid in the mould. In this connection, in Fig. 7 is shown a propeller shaft bracket casting just after easing has been completed. It will be seen here how the whole of the mould in front of the light end of the casting has been removed. This has been done

FIG. 16.—DIMENSIONAL CHANGES IN BUSH CASTING.

to enable that part of the casting to move in towards the heavy boss without being retarded.

The operation of easing takes place after the mould has been cast, and is a useless one unless carried out at the proper time, and at the correct places. Parts of the mould to be broken away to give ease of contraction must also be removed without any great effort, a condition which can only be obtained by anticipating this point during the moulding operation and making the moulds and cores weak.

The easing operation must be commenced at the parts of the mould near to the casting where cooling first takes place, leaving the other parts which cool later until a more appropriate time. The moulder who is working correctly always commences this operation by moving away the mould from the inside of runners, feeders, or other projections on the casting.

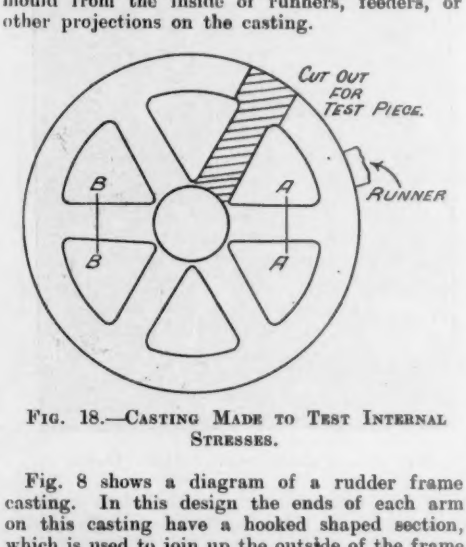


FIG. 18.—CASTING MADE TO TEST INTERNAL STRESSES.

Fig. 8 shows a diagram of a rudder frame casting. In this design the ends of each arm on this casting have a hooked shaped section, which is used to join up the outside of the frame with forged steel bar. These sections in the castings are only ¾ in. thick on the edge compared with the thickness of 18 in. in the thickest part of the same casting, shown in the vicinity of section "BB." It will be appreciated, therefore, that these light parts of the casting on the ends of the arms will be cooled very quickly after the mould is cast. This being the case, the easing operation must commence early in front of the hooked shaped pieces so as to allow these parts to travel towards the thick sections of the casting shown at "BB" and "CC." The supervisor or moulder, therefore, who is responsible for the manufacture of such a mould must anticipate these points during the moulding operations by making the moulds sufficiently weak so that the parts are easily removed a short time after the mould is cast. Serious contraction cracks may otherwise develop in the junctions adjoining the thick sections due to the contraction or travel being retarded.

The direction of travel during contraction of any casting is always inward, as was shown by Fig. 1, so that it is useless moving away parts of the mould which the casting is leaving during its contraction travel. In Fig. 9 a simple example is shown of a casting, marked "A," with two risers attached, which are shown at "B." "B." The contraction in a case of this kind would be from each end in the direction of the arrows. The sand which is shown at position "C," therefore, should be taken away first so that the movement in the direction referred to is not obstructed.

The contraction gaps left by the casting as shown at "D" will be seen to occur on the outside, and this occurs on every casting which is made in any class of metal, and to move away the sand shown at "E" becomes a useless procedure in practice, and is a waste of time.

The particulars just described are well known by the majority of foundry workers to be correct; but it is regrettable to have to say that there are still workers in some foundries who do not carry out the operation correctly and thereby cause their supervisors much trouble. It is suggested that such workers take careful note of this simple explanation, as it is considered to be of great importance to the quality of the finished product.

Further examples to give an idea of the commencing and finishing points when easing a casting are shown in Figs. 10 and 11. In a design of this kind the moulder should first ease away the sand in front of flanges "A," and whilst this is proceeding the coremaker should be removing the core "B." The sand in front of flanges shown at "C" should then be removed and almost at the same time sand obstructing the two points "D" must be taken away. The contraction travel to be attended to in turn by the operators are from "A" to "A," "C" to "B," and "D" to "D." It is important, therefore, to remove the parts of the mould (as near to the casting as possible) in front of these points.

In Fig. 11 another example is shown, and again the points at "A," "B," "C" should be removed all round the flanges, so as to allow them to move inwards to the point shown at "D." To facilitate removal at the parts mentioned in the examples shown in Figs. 10 and 11, it is essential during manufacture to construct the mould at these points on weak lines.

Fig. 12 shows the essential points in front of each flange. The cavities seen here are carried all round the flanges, and holes are linked up from them to the outside of the moulding box. This condition enables the operator to ease the sand away from the parts concerned without any great effort, and as a result without loss of time, which is an important matter.

The contraction movement in any casting always starts from the point where cooling commences. To explain this so that it will be more clearly understood, a sectional view of a pipe is shown in Fig. 13, cast on a declivity. The mould is 12 ft. long, shown at "E," and the cold casting size is 11 ft. 9¾ in. long, shown at "F," the contraction movement therefore being 2¼ in. It will be seen in this view that a feeder at "A" is used on the flange 4 in. thick, and the opposite end of the casting has a vent cast on it 2 in. dia. at "B," whilst the body thickness of the pipe is 2½ in. thick.

The casting is run at the position "C" so as to have the hot metal close to the feeder. It will be observed that this method brings about an immediate condition of two cooling rates. The reason for this is the extra bulk of metal at "A" and the runner point "C," causing

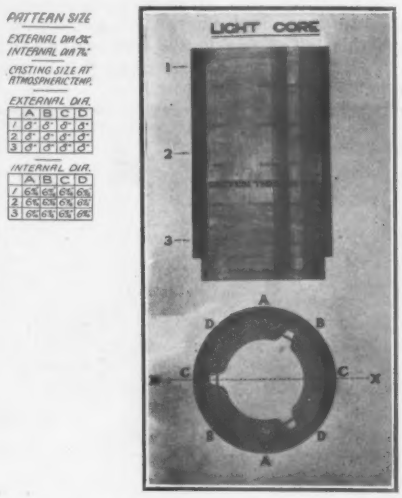


FIG. 17.—DIMENSIONAL CHANGES IN BUSH CASTING.

a hot spot at that end of the casting. The first point to commence cooling is obviously the one at "D," so that the direction of commencement of movement is firstly in the direction of arrow "H."

It might be thought by those not acquainted with the foundry that the movement would not occur uphill, but this does actually occur. The end of the casting at "D" proceeds to leave the mould first, and it does so whilst the other end (*i.e.*, the feeder end) is in a plastic condition. The critical part of the mould to break away or ease first in a case of this kind is the sand in front of the vent "B," and if this is not removed before "D" commences to move, a contraction tear is almost certain to occur at the position shown at "J."

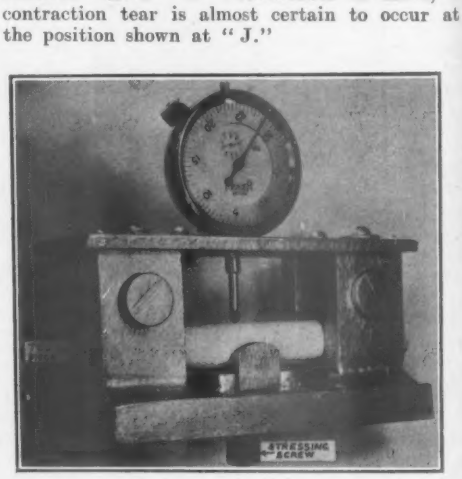


FIG. 19.—SPECIAL STRESS TESTING MACHINE USED.

The same job cast in a vertical position could be run at positions which are shown in Fig. 14. The runner in this case might be used at positions "A" or "B," with a feeder at "C." The hottest portion here is therefore at the feeder end, especially if it were run at "A." If a joint happens to be made in the mould

at the lower end, as is the case in many instances, it is possible to obtain a fin shown at "D." The first movement of contraction under the method described is in the direction of arrow "J," again on account of that being the first end to cool. The fin "D" at the bottom of the mould might in this instance cause a contraction tear to occur at "K" on account of the sand at "E" preventing the fin moving with the casting.

It will be appreciated that this fin would be thin and therefore stronger than the rest of the casting on account of its earlier cooling.

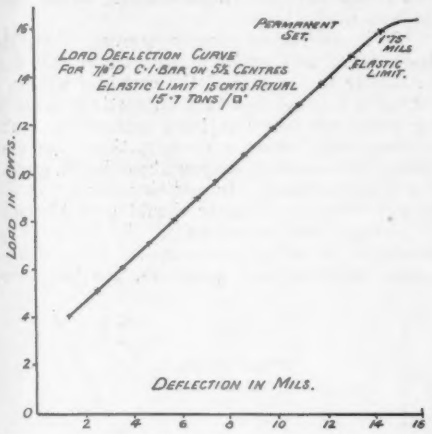


Fig. 20.—Load Deflection Curve for $\frac{7}{8}$ in. dia. Cast-Iron Bar.

Thus a small fin can be an anchorage and again cause the trouble under consideration. The other position of running this job might be at "B." This method would cause a hot spot at the bottom of the casting, and so somewhat delay the commencement of movement from that end, as compared with position "A." This being the case, one must attend to removing the sand at positions "H" and "L" where two retarding points occur.

At "H," the sand under the taper in the feeder is sufficient to cause trouble at "K," and the other position "L" is obstructed by the sand between that part and "F." The obstructed parts referred to, where it is necessary to remove the sand, are as shown in Fig. 7. The light end of the casting has been released by the removal of the sand, so that this part will move first as a result of it cooling earlier than the other end, which is much thicker in section. If such a precaution were not taken the hot tear difficulty would be almost certain to occur.

In addition to the form of crack described in the foregoing, another crack known as a split is occasionally seen in steel castings, and these are also caused through contraction stress. Such stresses are mainly produced by cooling the casting too quickly, or by local heating, welding, etc., and afterwards cooling in the air.

This form of crack, shown in Fig. 15, is sharper and better defined than the hot tear. Such a crack can also be caused by stress in some parts of the casting, due to contraction being propped by the use of heavily reinforced cores. This kind of crack, however, is more easily diagnosed than is the case of the hot tear, and the stresses producing it are easily removed by suitable heat-treatment. This is done on many occasions on castings which are designed with light sections of metal between two heavier sections, both in cast iron and steel.

Only recently a small investigation was carried out to illustrate how contraction can be held by using heavily reinforced cores. This consisted of making two cast-iron bushes, one with a heavily reinforced core and the other with a very light core. In Fig. 16 is shown one of these bushes, which is 12 in. long, the mould size, external diameter $8\frac{1}{16}$ in., and the internal core diameter $7\frac{1}{16}$ in. At A, B, C, D, the external and internal diameters were taken as shown at points 1, 2 and 3, indicated in Fig. 17.

This casting was made with what was considered a very strong or heavy core which was purposely reinforced with core irons. For this investigation five straight irons and three rings were used in the core as shown in the section and plan view. The casting was carefully measured after removal from the mould at the parts mentioned, and it is shown by the internal measurements that it has contracted $\frac{1}{16}$ in. A further bush was made from the same pattern and a core was made which had three grooves in it. A few light pieces of iron were used but much lighter than in the heavy core, Fig. 16. The core irons referred to are as seen in the section and plan view in Fig. 17.

It was found on measuring this casting that it had contracted $\frac{1}{8}$ in., *i.e.*, double the amount of that shown in Fig. 16. The cause of this is obviously the core shown in Fig. 17, allowing the casting more ease of movement than was the case with the core shown in Fig. 16. The measurements show that less contraction stress will exist in the casting made on the lines as indicated in Fig. 17 than will be the case in that shown in Fig. 16, because if the natural property of contraction is restrained, a stress must exist in the material.

In order to obtain natural contraction movement in any casting one must assist all parts to move at the same time. This condition is more easy to talk about than to obtain, especially where thicknesses vary so much in the many different shapes a foundryman has to contend with. If it were possible to design every part of a casting in even thickness, the foundryman could then control the cooling rate very easily.

It has often been stated that a casting designed on these lines sometimes gives more trouble than another with varying thicknesses. It is difficult to see how this can be possible, providing an attempt is made to obtain even contraction by keeping the cooling even. This would be possible by equal runner distribution, but this method cannot be carried out accurately where sections vary.

Good examples of this have been noted in the works where the authors are employed, during the manufacture of large gunmetal liners. These castings are always made in the horizontal position and give few contraction troubles. The method of manufacture is to have

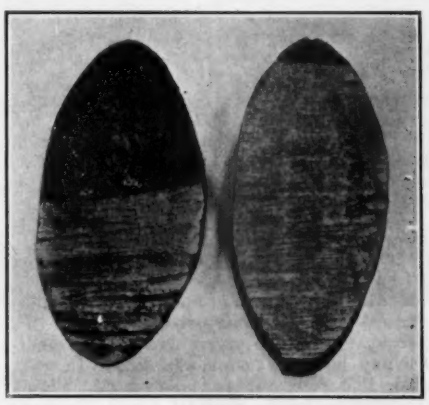


Fig. 22.—Sections of the Stressed and Unstressed Spokes.

the runners spaced equally over the full length of the casting, with the object of keeping the metal at a uniform temperature throughout the length. These liners have been cast up to a length of 38 ft. and although the casting is made in gunmetal, trouble could easily be experienced if the contraction was not evenly maintained.

The method of runner distribution is to set them out on the lines of equal cooling over the whole length.

The contraction on the liner casting was 6 in. so that the mould in which it was cast was 38 ft. 6 in., the casting size in cold condition being 38 ft. It has been mentioned only recently in a modern technical book that the contraction troubles in castings can be eliminated only by the designer fully appreciating basic principles. This is not altogether true, as however easy a design may be, to obtain good contraction the method of manufacture in respect of the running of the moulds, feeding, and the strength of moulds and cores have infi-

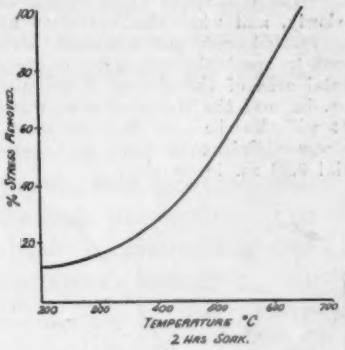


Fig. 21.—Stress Removal Related to Heat-Treatment.

nitely more to do with good results than has the question of design.

The example which has just been described of a gunmetal liner 38 ft. long is a tube of metal of even thickness throughout its length. It will be appreciated therefore that such a design is all that could be desired, and a perfect casting should be produced. Nevertheless, a good casting cannot be obtained unless the foundry supervisor makes the casting cool evenly by means of equal runner spacing.

Again, serious contraction faults can be caused in the foundry by anchorage of the casting at the ends through fins, or runners and risers not being eased by the removal of sand in front of them. The removal of sand needs to be carried out in front of the runners and risers first right on the extreme ends of the casting, and then each one in turn until the centre of the casting is reached.

This method of easing has already been described in Figs. 9 to 12, but in a case of this kind, every down runner from each end to the centre of the casting must be eased, otherwise the casting is almost sure to give trouble on water test. The trouble referred to is a result of microscopic tears due to uneven contraction from the ends to the centre. There is no doubt that this occurs because it has been proved during manufacture in the works where the authors are employed.

Casting Strain Research

In connection with the subject of strains an investigation was recently carried out by the authors on a wheel which was made in a dry-sand mould and cast from metal of the following composition:—T.C., 3.35; Gr., 2.57; C.C., 0.78; Mn, 0.51; Si, 1.78; S, 0.11; P, 0.39 per cent.

The wheel referred to is shown in Fig. 18, and it will be seen that the runner position is as shown on the rim and no risers were used on any part of the casting. The casting was allowed to cool to shop temperature before it was removed from the mould, so that no undue stress would be added by the casting cooling quickly in the air.

To obtain the maximum amount of stress which existed in the spokes of this wheel it will be appreciated that it was necessary to carry out the investigation regarding this point

immediately. Accordingly the casting was sent into the research department where it was taken from the mould. The method adopted to ascertain the nature of the stresses was to make two cuts which are shown at "AA" and "BB." At "AA" two marks were made which were 0.748 in. apart, and at "BB" two marks 0.750 in. apart.

After cutting, the marks at "AA" opened to 0.774 in. and "BB" to 0.765 in. Thus the spokes were in a definite state of tensile stress, as the increase at "AA" was 0.026 in. and at "BB" 0.015 in. As could only be expected, the stress having been partly released due to "AA" being cut first, the stress was less at "BB." The cutting of these spokes was done very slowly, and when this operation had been partly carried out the inherent stress was sufficient to break the remainder of the section. The total area of the section of the spokes was 0.67 sq. in. and the fractured area was 0.28 sq. in. It will thus be seen that the stress in the spoke was sufficient to fracture a bar of the material 0.28 sq. in. section.

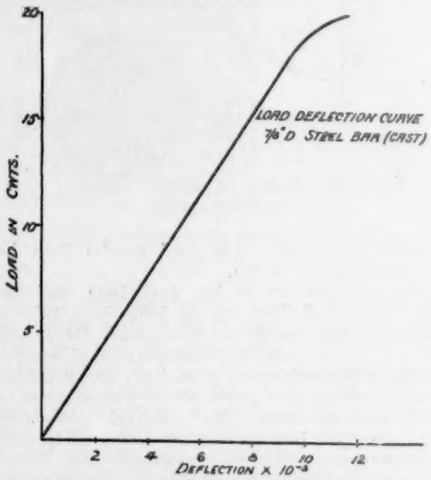


Fig. 23.—Load Deflection Curve for ⅞ in. dia. Cast-Steel Bar.

It was decided after this had been done that a test-bar should be cut from one of the spokes of the same wheel, which is shown shaded in Fig. 18. The U.T.S. value of this spoke returned 14.4 tons per sq. in.; therefore the force in the area which fractured

$$= 14.4 \times 0.28 \text{ tons},$$

and the stress in the spoke

$$= \frac{14.4 \times 0.28}{0.67} = 6.01 \text{ tons per sq. in.}$$

Stress Reduction

With a view to determining the correct heat-treatment temperature to eliminate or reduce such strains a further investigation was undertaken. When the wheel was cast a number of test-bars were cast at the same time and these were machined to 0.875 in. dia. One of these bars was used for a load deflection test set up in the apparatus shown in Fig. 19.

In this machine a pin was substituted for the screw so that a measurable load could be applied directly to the bar and measuring could then be done on the instrument shown. Small increments of load were applied to enable a stress strain curve to be prepared. This graph is shown in Fig. 20. It will be seen that the elastic limit in transverse was found at a load of 15 cwts., and the stress in the bar at this load was

$$f = \frac{WL}{4Z} = \frac{\frac{3}{4} \times 5\frac{1}{2}}{4 \times \frac{\pi}{32} \times 0.875^3} = 15.7 \text{ tons per sq. in.}$$

This stress corresponded to a deflection of 0.013 in.

The bars were then given a deflection of 0.008 in. by means of the screw shown in Fig. 19, this deflection corresponding to an induced stress of 10.5 tons per sq. in. The bars still held in the apparatus were then individually heated to progressively increasing temperatures and the elastic deflection remaining was measured. The results are set out in Table I.

Table I.—*Stress Removal by Thermal Treatment.*

Temp.	Bar No.	Initial def.	Permanent def.	Per cent. stress removed.
Deg. C.		In.	In.	
200	1	0.008	0.001	12.5
300	2	0.008	0.0012	15.5
400	3	0.008	0.0018	22.0
500	4	0.008	0.004	50.0
600	5	0.008	0.0065	81.0
650	6	0.008	0.008	100.0

Each bar was maintained at the stated temperature for 2 hrs., after which it was slowly cooled in the furnace. The figures show that a temperature of 650 deg. C. was necessary before the stress was completely removed, as is shown in Fig. 21.

In order to verify the conclusions arrived at it was thought advisable to cast a second wheel exactly similar to that shown in Fig. 18, and the same conditions were carried out so far as moulding practice was concerned, and this casting was heat-treated to 650 deg. C. and slowly cooled on exactly the same lines as the test-bars. After this operation had been completed, it was marked in exactly the same way as the wheel which was untreated had been and the amount of spring measured.

The original distance between the marks was 0.976 in., but after treatment this increased to 0.981 in., which is an increase of 0.005 in. This is compared with the increase of 0.026 in. on the untreated bar. The section of the cut and fracture were again measured with the following results—

Total area, 0.71 sq. in.
Area of fracture, 0.03 sq. in.

This represents a residual stress of $\frac{0.03 \times 14.4}{0.71}$ tons per sq. in. = 0.61 tons per sq. in.

In Fig. 22 the two sections of the spokes cut from the wheels can be seen. The one shown with the large fracture is without treatment and the other showing the small fracture occurring after treatment. From the investigation carried out on these two wheels it would appear that satisfactory strain relief in cast iron is obtained by heat-treatment at 650 deg. C. followed by slow cooling in the furnace.

The danger of shock load on any casting which contains strain of the type just referred to is the development of defects such as that which is shown in Fig. 15. It is admitted that the contraction stress in the cast-iron wheels which have been used for this investigation is one which may be associated with design, but such stresses can appear in a perfectly designed casting made in cast iron by using heavily-reinforced cores as illustrated in Figs. 16 and 17.

Casting Strains in Steel Wheels

After the investigation referred to had been carried out on the cast-iron wheels, it was thought that useful information could be obtained from the same pattern of wheel in cast steel by taking the stress existing in same before any heat-treatment was done. It was decided, therefore, to cast another two wheels in steel on exactly the same lines as those made in cast iron, together with the same number of test-bars. The analysis of the steel used for this purpose was as follows:—C, 0.28; Mn, 0.73; Si, 0.23; S, 0.042; and P, 0.038 per cent.

As before, two marks were made on one spoke, 0.75 in. apart; the spoke was then cut between the two marks, and, after careful measurement, it was found that it had extended to the extent of 0.022 in. In order to determine a suitable heat-treatment temperature to remove the strain in the second cast-steel wheel, the test-bars similar to those employed in the case of the cast iron were loaded with strain in transverse and afterwards treated at various temperatures.

The load deflection curve prepared from one of the bars is as shown in Fig. 23. This indicates the limit of proportionality at 0.009 in., and the bars for treatment were therefore loaded to give 0.007 in. deflection. From the results of treatment on these, a further curve (Fig. 24) was prepared, which indicates complete strain relief after a heat-treatment at 650 deg. C. After the treatment of these bars, the second wheel was then heat-treated to 650 deg. C., and it was then found that the strain existing in the casting was negligible.

This investigation clearly proved that the strain relief was entirely removed at 650 deg. C., similar to the case of the cast-iron wheels.

Thus it is suggested that all castings made in any metal are likely to have contraction faults in them, and, unless correct methods are used during the moulding stages, these faults appear in a greater degree. In addition, it is very important that the designer should give his careful thought and attention to the foundry requirements, as only by these means, coupled with careful heat-treatment processes, can hot tears,

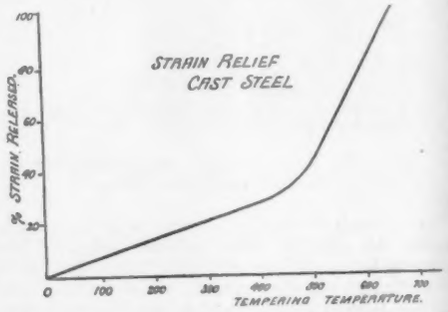


Fig. 24.—Thermal Strain Relief Curve for Cast Steel.

cracks and strains in castings be avoided or removed.

The authors would like to mention that the defects caused by contraction in the casting or castings in any metals are associated with many other subjects which have not been entered into in this Paper. Many of these subjects were briefly put forward in a previous Paper.*

In conclusion, the authors would like to thank the directors of Vickers-Armstrongs, Limited, especially Sir Charles Craven, Mr. Callander and Sir Robert Beeman, for their kindness in allowing them use of some of the photographs reproduced, and also for the stimulating interest they have taken in the preparation of this Paper.

Key Industry Duties

ADDITIONS RECOMMENDED

A committee which was appointed by the Board of Trade recommends that the key industry duties imposed by Part I of the Safeguarding of Industries Act, 1921, as amended by the Finance Act, 1926, and the Finance Act, 1934, should be renewed in their present form for a further period of ten years at not less than the existing rates. Certain additions to the schedule are recommended. The duties are due to expire on August 19. The committee recommend that ferro-titanium commercially carbon-free; carbon-free manganese metal; and chromium metal should be added to the schedule of articles chargeable with key industry duty at a rate of 33⅓ per cent. *ad valorem*, and that extension of the duties to these articles should be made effective with as little delay as possible.

In Mr. Chamberlain's Budget speech on April 21, it was indicated that the existing key industry duties would be renewed for ten years, with some additions.

* Foundry Trade Journal, August 15, 1935, *et seq.*

Why Stanton-Dale Iron is used for Morris Cylinder Blocks

STRENGTH, machineability and resistance to wear—qualities essential in castings for intricate machinery parts—can be secured at moderate cost by the use of Stanton-Dale Refined Pig Iron.

The use of even a small proportion of this low-carbon pig iron gives the closening-up of grain, and general uniformity, which indicate superior physical properties. For this reason, Morris Motors Ltd., whose specialisation and systematic production demands consistent materials, are regular users of Stanton-Dale Iron.

Stanton-Dale Refined Pig Iron is supplied in special section clean pigs, broken into halves.

MORRIS

Full analyses of the nine standard grades will gladly be sent on request.

STANTON
DALE
REFINED
PIG IRON

The largest Producers of Foundry Pig Iron (for Sale) in Great Britain

The Stanton Ironworks Company Limited, Near Nottingham

Art and Craftsmanship*

By F. GENTLES

Everybody is acquainted with the phrase "Change and decay." These words, while they are not synonymous, have a very distinct relation. Most people remember the "growler" and the hansom cab, which were ubiquitous in the streets of London some twenty years ago, and the development and transformation that have taken place, resulting in the modern taxi-cab replacing the old horse-drawn vehicles. It is an interesting speculation as to what happened to the craftsmen employed in making the "growlers" and hansom cabs, especially during the early transition stages from the cab to the taxicab. No doubt many of the firms and craftsmen who were employed in the making of "growlers" and hansoms did show sufficient foresight and resiliency to see the change coming, and to develop along the lines of the new demand. There still remains, however, a lingering thought that there must have been many firms and many craftsmen who suffered in economic consequences during, and as a result of, the change-over.

The foundry industry and craft to-day may truly be said to be bordering on, if not actually in, a transition period, and a very definite query arises: "Have we in the industry the executives and the men with sufficient foresight and the flexibility of mind to realise and appreciate the importance of what the new demands may mean?"

Mr. Blackwell, in his presidential address to the London Branch of the Institute this session, truly stated that the god of speed was not confined to the roads and the air; it was also in the workshop to-day, and there were no Belisha beacons for safe crossings.

In the engineering industry there has been during the last ten years a very definite and progressive evolution in fabrication of many mild-steel parts which have been, and are being, used to the exclusion of iron and steel castings, and it is recorded that a 5-ton electric jib crane has been erected, built solely of mild-steel welded parts in which there was neither an iron nor a steel casting. It is probably correct to say that the suppliers of large electrical equipment have carried fabrication to-day to a limit undreamt of when welding was first thought of. True it is that many engineers, and more particularly those represented by the War Office and Admiralty Government Departments, are very loath to accept fabricated materials in preference to iron and steel castings, but foundrymen must not blind themselves to the fact that many progressive engineers are to-day converted to welded steel parts and that many plants are running with altered designs to suit the new products.

The question resolves itself more or less into one of economic production, and I think it is generally accepted that fabricated mild-steel parts in very many cases can be produced cheaper than corresponding cast-steel parts. Can founders, then, with the metallurgical knowledge at their disposal, so improve the quality of cast iron that they can produce high-duty cast irons at such competitive prices as will meet the competition of fabricated materials?

There was two months ago in the London Branch a very interesting and able Paper delivered by Mr. Robiette, which undoubtedly gave a line of thought to all serious foundrymen, and a very definite lead on the problem of the production of high-duty irons in the electrical furnace. In that Paper Mr. Robiette gave production-cost figures which indicated that here was one field at least in which the foundryman will be enabled to produce castings of a high service value at prices which should meet the competition of fabricated parts. There are other aspects of this question which will occur to many, but which cannot be dealt with *in extenso* in the time available, and these must therefore be left open for discussion.

Ornamental Castings

Leaving the engineering side and turning to the production of light castings in the ornamental and domestic-utility sphere, the outlook, though relative, is not exactly similar. It is doubtful if there are as many ornamental castings being turned out of British foundries to-day as there were in pre-war days, and this is probably accounted for by the changed outlook of architects and designers in these modern times of straight lines and right-angles. Foundrymen, when next they are in Oxford Street, should pause a moment to look at the cast-iron columns, pillars and lintels of the Selfridge building. There they will find an illustration of the truth of Keat's quotation that "a thing of beauty is a joy for ever." The question naturally arises, "Why, having the foundry craftsmen, who undoubtedly exist, capable of producing such castings, should the industry be suffering from such a decline in the production of ornamental work, as apparently is the case to-day?"

Castings in the Kitchen

In the domestic utility sphere the managing director of one of the best-known firms in the gas stove trade, in a very able review of the industry, recently stated that the modern housewife was becoming "kitchen proud," and it was not sufficient that the cast-iron kitchen requisites should be merely utilitarian: they should, additionally, have some appeal both in form and colour to the artistic sense. Everybody is aware of the development which has taken place in recent years in vitreous enamelling in the light castings trade to meet the demand of the housewife in this respect, showing that the people primarily concerned in the manufacture are alive to the possibilities.

The attainment of the present degree of excellence has not been arrived at without a good deal of trial and error and much careful investigation, carried on systematically in a manner which was probably unknown in the light casting section of foundry work a generation ago. Although such standards have been reached it is not sufficient for us to regard foundry work as having been accomplished, as there is still the possibility that synthetic productions or pressed sheet metal work may at any time become a serious competitive factor. Many advanced concerns have set out to meet such possible competition, but it is safe to say that the day has not yet been lost or won, and it behoves all engaged in the industry to cultivate a broad outlook and a mind always open for the consideration of new ideas if the position already gained is going to be maintained. Continuous casting plants, careful control, and scientific analyses of the metals used have all gone to contribute their quota, but even more intensification along those lines is essential if foundrymen are to keep their place in the sun.

* A Short Paper Competition entry to the London Branch of the Institute of British Foundrymen.

THE PARTNERSHIP between Messrs. Thomas Henry Neville, Charles Robert Neville, Francis John Neville and Arthur Cooper Neville, carrying on business as engineers and ironfounders, at 21 and 22, Hatherton Street, Walsall, under the style of T. C. Neville & Sons, has been dissolved by mutual consent. Debts will be received and paid by Messrs. T. H. Neville, C. R. Neville and A. C. Neville, who will carry on the business in partnership under the style of T. C. Neville & Sons.

Teething Troubles

Mr. F. Gudgeon—an engineer—in a Paper which he gave to the Derby Society of Engineers, made reference to the teething troubles experienced in putting a continuous casting plant into operation.

The plant was started in October, 1934, and, as was to be expected, trouble in varying degrees was experienced straight away. The human element did not take too kindly to it at first, and was a bit scared of it, and in addition was worried about possible reduction in pay, but these difficulties were soon overcome.

The greatest difficulty was in getting all the moving parts properly synchronised. To start with, the sand was either holding up in the bunkers or else overflowing. The speed of the conveyor had to be adjusted to enable the pourers to keep time with the moulders, and what was most difficult of all the rate of melting in the cupolas had to be found. The plant was started off with the cupolas discharging into a receiver placed centrally between them, the idea being to keep the metal as hot as possible, and then to run it from the receiver into hand ladles, but the difficulty was to regulate the rate of melting to the rate of making moulds and pouring, and for the first two or three days there was a great deal of trouble.

First both the receiver and the cupola became full, and the iron could not be used fast enough. The next day, although the staff had warmed up, the lining of the receiver, when it was filled with metal, froze and could not be got out, and as something had to be done quickly it was decided to lift the receiver out bodily with the crane and a 5-cwt. ladle mounted on a bogie was installed in its place, and this had been used ever since.

The next trouble was with the sand. The plant started with the mixture which had previously been used in the shop, but it was found that the bond was affected on the continuous plant due to it being used more frequently and not having had time to cool thoroughly. Various experiments were tried, changing the percentage of new sand, coal dust and moisture and altering the size of the sand grain, but still there was a certain amount of trouble.

Experts on sand were called in, and the first one said that the trouble was entirely due to the high percentage of silt and this could be overcome by using coarser sand, also that the moisture was too high. Then another insisted that the sand was too coarse and the moisture was too low, so after that it was concluded that the internal staff had better continue experimenting and find out for themselves what the right mixture should be. Actually the sand now being used does contain a higher percentage of silt than the shop sand, and is quite hot, about 95 deg. Fah., when it comes out of the bunker. The moisture has been found to be best when kept about 5 per cent.

As regards results, the plant can make about 2,300 moulds a day from 10 machines and pour about 22 tons of metal, the scrap on an average being of the order of 4 per cent.; this includes wastage by men, breakage, defective moulds, and metal faults.

The plant is run continuously from 7.55 a.m. to 5.30 p.m., and is shut down on Saturday mornings for cleaning and general maintenance, the vital point, of course, being to see that this maintenance is thoroughly carried out, especially the greasing, otherwise considerable wear will take place.

Up to now there has been no major replacement to make other than an occasional bearing and two of the cast-iron table tops which have been broken due to an accident.

There has only been one complete day's shut down due to breakdown, and this is due to the efficiency of the maintenance staff to keep everything in good condition.

F.T.J. 30.4.36.

B·A·/5 for HEAT-TREATED CASTINGS..

Heat-treatment has come to stay. Where the necessary plant is available, this process, by substantially adding to the strength of the metal, enables castings to be designed with thinner sections for any required strength and stiffness. No. 5 alloy is probably the cheapest and simplest heat-treatable alloy available. It is widely used for cylinder heads and similar applications where stiffness at elevated temperatures is needed.

Prices, properties and information on correct heat-treatment on application to the Company, Ref: DEV.

The BRITISH ALUMINIUM Co. Ltd.

HEAD OFFICE: ADELAIDE HOUSE, KING WILLIAM STREET, LONDON, E.C.4.

Telephone: Mansion House 5561 & 8074 (5 lines). Telegrams: CRYOLITE, BILGATE, LONDON.

LONDON WAREHOUSE: 25-29 Pancras Road N.W.1. | BIRMINGHAM, 4: Lawley Street | MANCHESTER, 3: 274 Deansgate | LEEDS, 3: 66 Kirkstall Road | NEWCASTLE-ON-TYNE, 1: Milburn House | GLASGOW, C.2: 113 West Regent Street

AND AT NEW YORK, TORONTO, MONTREAL, CALCUTTA, SYDNEY, AND JOHANNESBURG.

WARNER Special PIG IRONS

- Warner C.B.R. and
- Low Carbon Cylinder (FOR CYLINDERS, ROLLS, ENGINEERING CASTINGS, ETC.)
- Low Carbon Malleable (FOR MALLEABLE CASTINGS OF ALL DESCRIPTIONS)

Supplied to any specification between limits of 2·00 and 3·50% Carbon and ·50% and 3·50% Silicon

ACTUAL ANALYSIS CERTIFICATES ARE AVAILABLE WITH EACH DELIVERY

● **Typical Cylinder Pig Iron Specification**

TOTAL CARBON	2·70%
SILICON	1·80%
MANGANESE	·90%
SULPHUR	·06%
PHOSPHORUS	·40%

● **Typical Malleable Pig Iron Specification**

TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

WARNER & CO., LTD
CARGO FLEET MIDDLESBROUGH

This Week's News in Brief

Trade Talk

ALL WHOLESALE MERCHANTS of special steels in Germany have been formed into a compulsory cartel under the iron and steel trade group.

THE MINERAL PRODUCTION of Tasmania in 1935 included 123,714 tons of coal, 25,555 tons of pyrites, 1,131 tons of tin and 232 tons of wolfram.

MEMBERS OF THE Midland Sectional Council of the National Society of Brass and Metal Mechanics held a conference in Derby last Saturday.

A PETITION FOR THE WINDING-UP of the Patent Axle-Box & Foundry Company (1934), Limited, by the High Court of Justice was heard on April 27.

THE CAPITAL REORGANISATION SCHEME of the Consett Iron Company, Limited, was approved by a majority at meetings of the ordinary and preference shareholders.

THE PULSOMETER ENGINEERING COMPANY, LIMITED, Reading, are to supply filtration plant for the swimming pool at the Royal High School, for Edinburgh Town Council.

NO. 3 BLAST FURNACE of the Workington Iron & Steel Company, branch of the United Steel Companies, Limited, is being lit after relining during this week-end.

A FIRE BROKE OUT in the heat-treatment department of the steelworks of Samuel Fox & Company, Limited, of Stocksbridge, Sheffield. Three brigades were called to deal with it.

WILLIAM DENNY & BROS., LIMITED, Dumbarton, have received an order from the L.M.S. Railway Company for a cargo and livestock vessel for the Holyhead and Dublin service.

THE UNION OXIDE & CHEMICAL COMPANY, LIMITED, have removed to Plantation House, Fenchurch Street, London, E.C.3. Their telephone numbers are Mansion House 2184 and 6783.

H. HILDITCH, LIMITED, metal manufacturers and merchants, of 244-245, Heneage Street, Birmingham, 7, have moved their London office to Sentinel House, Southampton Row, W.C.1. The telephone number is Holborn 9200.

PIG-IRON PRODUCTION in the Soviet Union totalled 3,400,000 metric tons in the March quarter, as against 2,915,000 tons in the corresponding period of last year, while steel output was 3,780,000 tons, against 2,780,000 tons.

LAST FRIDAY and Saturday, the metallurgists and foremen of the various British Meehanite licensees were in conference with the staffs of Winget, Limited, of Rochester and Ealing Park Foundry, South Ealing, each firm acting as hosts in turn.

THE ANNUAL EASTER TOUR undertaken by the students of the Paris Foundry School this year embraced a visit to the foundries and steelworks in the Belfort and Mulhouse regions. The party was in charge of Mr. Ronceray, the director of the school.

THE DEPARTMENT OF OVERSEAS TRADE announces that the British Industries Fair will take place next year from Monday, February 15, to Friday, February 26, in London and Birmingham. In addition to Olympia, the Department has leased the new exhibition buildings now under construction at Earl's Court.

A SPECIAL MEETING of shareholders of the South African Manganese Company at Johannesburg on April 21 approved the directors' proposals to increase the capital by £62,000. The new money is required to finance developments and to enable the company to take advantage of further favourable opportunities.

ENDEAVOURS ARE BEING MADE to ascertain the extent of the lead deposits remaining in the Leadhills and Wenlockhead district of Lanarkshire, and the possibilities of development. A new vein has been located on property belonging to the Marquis of Linlithgow. A survey has been made, and further exploratory work is to be carried out.

IN HIS BUDGET SPEECH last week the Chancellor of the Exchequer announced new assistance for the "special areas." A company, to be called the Special Areas Reconstruction Association, Limited, with a nominal capital of £1,000,000, is to be formed to finance small businesses in these areas. Advances are to be limited to £10,000 in any one case.

MR. AND MRS. F. BIRCHALL, of Doncaster, have given £1,000 to start a trust fund to be used for benevolent purposes among the employees of Peglers, Limited, Belmont Brass Works, Doncaster, of which Mr. Birchall is a director. In memory of their son Leslie, it is to be known as the Leslie Birchall Memorial Fund. It will be administered by trustees drawn from the directors and employees.

A CONFERENCE FOR WORKS and office engineers and executives on electric lighting is to be held in London on May 19 and 20. The speakers, who are experts in their subjects, will deal with the problems in a practical manner and illustrate their remarks with convincing demonstrations and lantern slides. During the proceedings special consideration will be given to the practical application of the new electric discharge lamp. At the conclusion of each session ample opportunity will be afforded for discussing the problems of the individual members of the audience. The data and information obtained cannot fail to prove of the utmost importance to works executives, and will enable them to procure a properly-planned lighting installation in their own factory. Seats may be reserved on application to Mr. W. J. Jones, manager of the E.L.M.A. Lighting Service Bureau, at 2, Savoy Hill, London, W.C.2.

Company Reports

Murex, Limited. — Interim dividend of 2s. per share on the ordinary shares.

Lancashire Steel Corporation, Limited.—Dividend on first preference shares declared for six months to April 30, 1936.

Herbert Morris, Limited.—Dividend for the half-year ended January 31 on the ordinary shares at the rate of 5 per cent., free of tax.

Laurence, Scott & Electromotors, Limited.—Net profit of £22,096, which, after deducting the debit balance brought in from 1934, leaves a credit of £5,681 on revenue account to go forward. Meeting, April 29.

British Oxygen Company, Limited.—Final dividend on the ordinary stock, including the free bonus shares recently issued, for the year ended December 31, 1935, of 8 per cent., making 15 per cent., plus capital bonus of 28 4-7 per cent.

Imperial Chemical Industries, Limited. — Full report for 1935 shows that the net income of the company, after providing £1,000,000 for the central obsolescence and depreciation fund and £645,891 for income tax, amounts to £6,706,539. After allocating £1,000,000 to general reserve, £217,366 to contingent dividend reserve and £150,000 for the workers' pension fund, the balance for the year is £5,339,173, which, with £608,451 brought forward from 1934, gives a total of £5,947,624. The directors have decided to recommend on the £43,759,759 ordinary stock resulting from the conversion into stock of ordinary shares, a final dividend of 5½ per cent., making 8 per cent. for the year, and, on the further £5,4"4,141 ordinary stock (resulting from the conversion and consolidation of 21,736,564 deferred shares of 10s. each), a dividend of 4 per cent., leaving a balance of £638,740 to be carried forward to 1936. The directors have also decided to recommend a further dividend on the £5,434,141 ordinary stock of 4 per cent. This will make the full 8 per cent. The board have set aside £217,366 out of the profits of the company sufficient to pay this dividend.

Contracts Open

East Yorks.—Cast-iron and spun-iron pipes, cast-iron specials, etc., to British standard specification, for the Howden Rural District Council. Mr. J. H. Haiste, civil engineer, Middleton Chambers, Lowgate, Hull.

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Robert Harlow & Son, Limited, 44, Wellington Road North, Heaton Norris, Stockport.—Capital, £20,000. Brassfounders and engineers. Directors: B. S. Harlow and F. G. Harlow.

Personal

MR. S. HADFIELD, of Thos. W. Ward, Limited, has changed his address from 37, Frederick Road to 77, Tamworth Road, Sutton Coldfield.

MR. G. R. WEBSTER, works manager of the Britannia Iron & Steel Works, Limited, is at present making an extended business visit to the Continent.

MR. J. DUNLOP ANDERSON, M.A., B.Sc., has been elected chairman of the Scottish branch of the Institution of Structural Engineers. Mr. Anderson has been vice-chairman of the branch for the past five years.

MR. WILLIAM WYLLIE has received a presentation on his retirement after 40 years' service with the Carron Company of Falkirk. He is 81 years of age and recently celebrated the 50th anniversary of his wedding.

MR. A. T. DAVEY, manager of the spun-iron pipe plant at the Stanton Ironworks Company, Limited, has been appointed general works manager of David Brown & Sons (Huddersfield), Limited, gear manufacturers, Huddersfield.

MR. F. J. PASCOE has been elected a director of G. D. Peters & Company, Limited, of Slough. Mr. Pascoe is also a director and the financial adviser of British Timken, Limited, and is chairman of the Neckar Water Softener Company, Limited.

MR. O. WASS.

MR. O. WASS has been appointed to the board of local directors of General Refractories, Limited. Mr. Wass is principal assistant to the sales director, Mr. George Senior, and has been with the company for over twelve years. Prior to joining General Refractories, Limited, he had a great deal of experience with a number of the leading steel manufacturers.

MR. I. J. HAWKE, general sales director of the Carborundum Company, Limited, has sailed for the United States, where he will make a close study of modern engineering practice, particularly with regard to the abrasive and kindred industries. Mr. Hawke is due to return to England on July 1.

Wills

WARBURTON, G. H., managing director of Marsden's Engines, Limited, iron-founders, of Heckmondwicke £7,538

Obituary

MR. WILFRED BUTLER, director of Butler & Son (B. & S. Valves), Limited, engineers and brassfounders, of Dukinfield, died last week.

THE DEATH occurred suddenly, on April 24, of Mr. David Alexander Blair, chairman of Blairs, Limited, the well-known firm of sugar-machinery engineers.

THE DEATH OCCURRED, on April 22, at the age of 63, of Mr. Herbert Arnold Smith, governing director of B. G. Smith & Sons, Limited, brassfounders, of Halifax. Mr. Smith was a leading figure in the Northern Brassfounders' Association, of which he was President for ten years. In the course of his business he did much travelling and took a close interest in the affairs of the National Commercial Travellers' Association, and was a governor of the Pinner Schools.

Forthcoming Events

MAY 6.

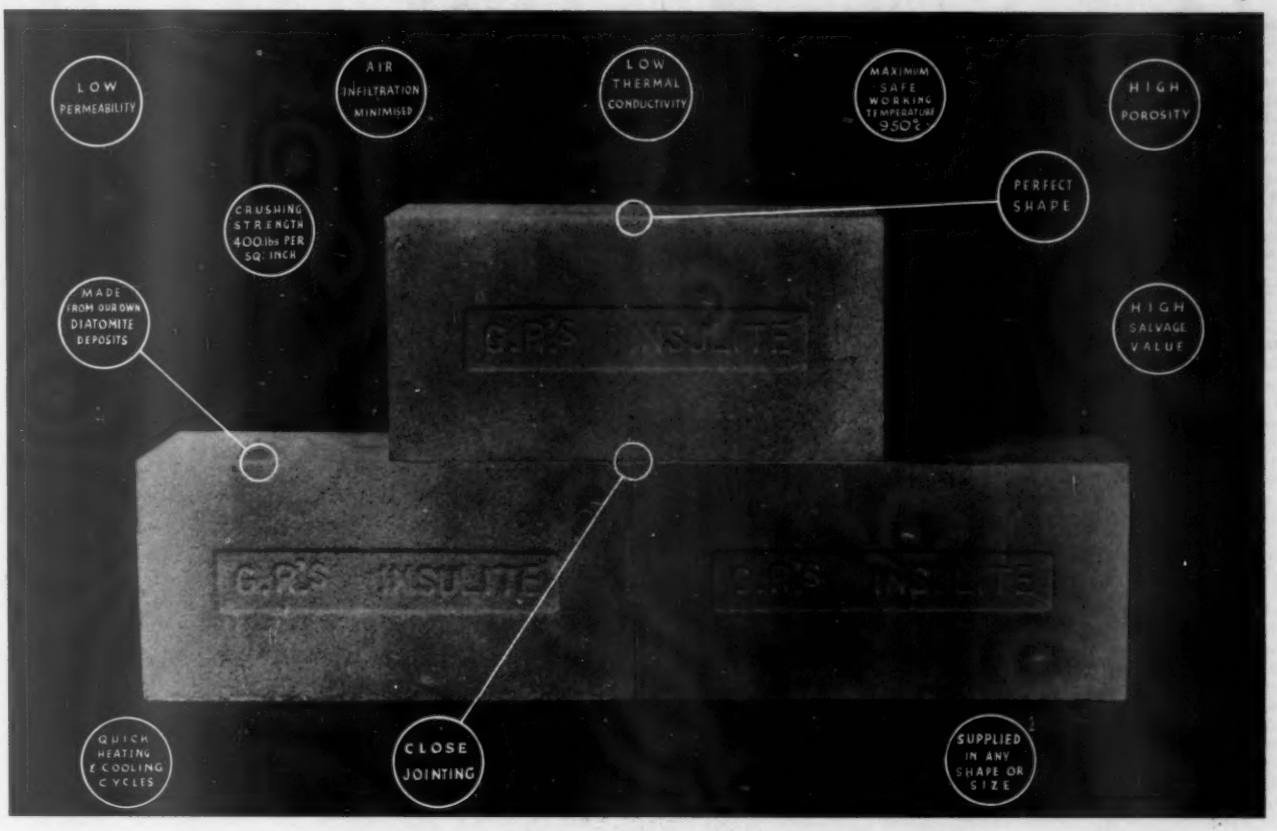
Institute of Metals:—Twenty-sixth annual May lecture, at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

MAY 7-8.

Iron and Steel Institute:—Annual Meeting in London, at the Institution of Civil Engineers, Great George Street, S.W.1, at 10 a.m.

MAY 8.

Institution of Mechanical Engineers:—Informal Meeting, at Storey's Gate, St. James's Park, London, S.W.1, at 7 p.m.



Save 80% of waste heat and reduce fuel costs by 20% with INSULITE BRICKS

By efficiently insulating the foundations and walls of Open Hearth furnaces and Regenerator Chambers, Mould and Core Drying Stoves, Blast Furnace Plant (including Cowper Stoves), Blast Pipes, Annealing and Heat-Treatment Furnaces and Enamelling and General Furnaces —whether heated by solid fuel, gas, oil, or electricity—with Insulite bricks it will be found that there is a saving of 80% of waste heat, fuel costs are reduced by as much as 20%, and production costs are accordingly reduced to a minimum. These bricks also reduce the heat capacity of furnace and stove structures, thereby diminishing the time required to reach top temperature. Although Insulite bricks owe their peculiar properties to their cellular structure it must be remembered *that these cells are closed* and are thus impervious to gases . . . . the serious effects of air infiltration are therefore minimised by the insulating layer. Insulite bricks have extremely high crushing strength of 400 lbs. per sq. inch. Specimen bricks have been removed from behind the lining of plants working at 1,500°C.—these bricks are still perfectly efficient after over 8 years' service.

As each type of furnace has its own peculiarity please write for further particulars to the sole manufacturers of Insulite bricks—our Technical Staff will be pleased to assist without obligation.

GENERAL REFRACTORIES Ltd.,

Genefax House, Sheffield.

Telephone: Sheffield 31113 (6 lines). Telegrams: "Genetax, Sheffield."

London Office:
Russell House,
Adelphi, W.C.2.
Telephone: Temple Bar 7361.
Telegrams:
"Genefax, Rand-London."

Scottish Office:
156, St. Vincent St.,
Glasgow.
Telephone: 5250.
Telegrams:
"Genefax, Glasgow."

South Wales Office:
11, Wind St.,
Swansea.
Telephone: 3680.
Telegrams:
"Genefax, Swansea."

MANUFACTURERS OF HEAT RESISTING AND HEAT INSULATING MATERIALS OF EVERY DESCRIPTION.

Raw Material Markets

The demand for supplies of iron and steel remains in excess of production, but business since the Easter vacation has declined, owing to producers being so heavily booked that they are not inclined to increase their commitments at current prices. Costs of production are rising and quotations are likely to advance. Coke supplies continue to be short, and in this respect the satisfactory result of the negotiations between the Cumberland coke workers and their employers is a relief. Several months work is assured to the steel mills by their heavy rolling programmes. Prices of basic pig-iron have been raised by 2s. 6d. per ton.

Pig-Iron

MIDDLESBROUGH.—Out of 30 blast furnaces operating in this area there is not one making Cleveland iron, all being engaged on the manufacture of steel-making irons. Supplies from other areas are therefore being taken up on a good scale. Producers are not willing to enter into contracts for delivery before the third quarter of the year, when prices will have been raised by 5s. per ton. Current values are nominal, with No. 3 Cleveland G.M.B. at 70s. per ton in the Middlesbrough and Falkirk areas, 72s. on the North-East Coast and 73s. on Clydeside.

In spite of the increased output of hematite the demand continues to be more than the makers can cope with and little business can be transacted for delivery during the next few months. Trading on export account only amounts to a very low tonnage. Fuel costs have been raised and it is anticipated that quotations will become higher after the end of July. No. 1 East Coast hematite is now being delivered in the Middlesbrough, Durham, Northumberland and Scottish areas at 77s. per ton, this being the official minimum figure.

LANCASHIRE.—Consumers of common irons are imposing a heavy pressure on the makers for deliveries against contracts. Producers are naturally reluctant to enter into any new business, but a few transactions have been made at higher prices and with no stipulation concerning delivery. Local foundries continue to have well-filled order-books. For delivery up to June 30, quotations for Derbyshire, Staffordshire and Lancashire brands of No. 3 foundry iron are more or less nominal on the basis of 78s. per ton, including delivery to Lancashire works, with Northants at 76s. 6d., and Derbyshire forge iron at 74s., and delivery after June 30 at 5s. per ton more in each case. Hematite is in short supply for near delivery, and values are firm at around 85s. 6d. per ton for West Coast material and from 84s. 6d. to 85s. for East Coast. Scottish No. 3 foundry is quoted at around 89s., for delivery in the Manchester district.

MIDLANDS.—The call for supplies against existing contracts is such that makers are having to draw on their already small stocks. Prices remain unaltered, the controlled figures being 72s. 6d. for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, delivered Birmingham and Black Country stations, with 11d. per ton extra if delivered into works in 10-ton lots. Special-quality irons are experiencing a good demand from the general engineering and jobbing trades. Prices are not controlled and vary considerably. Medium-phosphorus iron is quoted at from 80s. to 87s. 6d., low-phosphorus 92s. 6d. to 100s., and refined from £6 10s. to £7 15s. per ton, delivered South Staffordshire area. Costs of production are now higher, and any alteration in the above values will undoubtedly be in an upward direction. Active conditions continue to prevail on the hematite market, and many makers are unwilling to accept any new business. Prices of iron for delivery up to the end of July are £4 8s. 6d. for West Coast mixed numbers, £4 7s. 6d. for East Coast No. 3, and £4 7s. for Welsh mixed numbers, delivered local stations, with 1s. 6d. per ton extra if delivered into works. It is reported that several manufacturers have fallen into arrears with deliveries.

GLASGOW.—Steel-making iron continues to receive many inquiries, but the demand for Scottish foundry iron has declined slightly. Prices are unchanged, No. 3 Scottish foundry iron being officially quoted at 79s. f.o.t. furnaces, with 2s. 6d. extra for No. 1. The light-castings founders are still very active, but much of their requirements of Cleveland iron remains unsatisfied. Meanwhile, values for No. 3 Cleveland iron are unchanged at 70s. f.o.t. Falkirk and 73s. f.o.t. Glasgow, with other English foundry irons nominally at 1s. 3d. per ton less. Steelmaking irons are well taken up, and quotations are as follow:—Mixed numbers Scottish, West Coast and East Coast hematite, 77s.; basic, British and Indian, 72s. 6d. (less 5s. rebate). The price of the latter has been raised in the course of the last few days by 2s. 6d. per ton. The foregoing figures are all inclusive of delivery to local steelworks.

Coke

The demand for cupola coke remains unabated. Many users whose contracts were concluded recently have not renewed them, as they are hopeful that lower prices will rule in the next month or two. However, no indication of this has been forthcoming from the makers, who remain very firm in their attitude on this question. Current values of best Durham foundry coke, including delivery in Birmingham and district, are from 41s. 6d. to 43s., and Welsh coke varies, according to quality, from 38s. 6d. to 50s. per ton.

Steel

A rather quieter tone has developed in the market, but this is a seasonal movement which may have become slightly accentuated this year owing to expectations that prices of some descriptions will be raised in the near future, states the official report of the London Iron and Steel Exchange. All departments of the industry are busily employed and specifications against contracts are reaching the works at such a rate that the makers find it impossible to keep pace with deliveries. The situation in the semi-finished steel department has become somewhat easier as a result of the distribution of considerable imports of foreign material, by arrangement with the British Iron and Steel Federation. All the British producers of semis are booked up for a long time ahead, and it is practically impossible to place orders for certain descriptions for any reasonable delivery. Many consumers have bought well forward, but have been obliged also to enter the market to supplement their contracts. In the finished-steel department a quieter trend in business has been noticeable. Specifications continue to reach the works at a satisfactory rate, however, and there is great pressure on the part of buyers to secure delivery.

Scrap

Good, heavy, melting steel in the Cleveland area remains at 57s. 6d. per ton delivered works, while 62s. 6d. is being paid for ordinary heavy foundry cast iron, and 65s. for good machinery metal, in handy sizes. Little change can be reported on the Midland market, all descriptions receiving attention. Good, heavy, wrought-iron scrap is at 67s. 6d. to 70s., while short, heavy, steel scrap, as used in the foundries, remains scarce at 67s. 6d. Heavy machinery metal, in cupola sizes, is at 67s. 6d. to 70s., good heavy at 65s., and clean light at 52s. 6d. to 55s. per ton, delivered works. Scrap material is being imported on a considerable scale in the Scottish market, and little shortage is now being experienced. Wrought-iron scrap is firm at 70s., but in some cases a little more has been obtained. Machinery cast-iron scrap, in pieces not exceeding 1 cwt., is still firm at 71s. 3d. to 72s. 6d., while ordinary cast iron, to the same specification, is about 3s. 6d. per ton less, delivered f.o.t. consumers' works.

Metals

Copper.—Buying has been on an improved scale recently and the tone of the market is sound. The effects of the Budget on all the metal markets have been less than was anticipated. On Thursday of last week prices of copper advanced to the highest levels reached since July, 1933. The turnover on that day was 2,400 tons. The announcement that the Central Electricity Board is undertaking considerable extensions has been well received, for a substantial tonnage of copper will be involved in the scheme. Favourable conditions prevail in the United States, although buying has been on a rather lessened scale.

Daily market prices:—

Cash.—Thursday, £37 10s. to £37 11s. 3d.; Friday, £37 8s. 9d. to £37 11s. 3d.; Monday, £37 10s. to £37 11s. 3d.; Tuesday, £37 3s. 9d. to £37 5s.; Wednesday, £37 to £37 1s. 3d.

Three Months.—Thursday, £37 13s. 9d. to £37 15s.; Friday, £37 15s. to £37 16s. 3d.; Monday, £37 15s. to £37 16s. 3d.; Tuesday, £37 10s. to £37 11s. 3d.; Wednesday, £37 6s. 3d. to £37 7s. 6d.

Tin.—This market has become steadier during the past week, but little of importance is to be recorded in the way of buying interest. World consumption of tin rose considerably in the twelve months ended February, 1936, and according to the April issue of the International Tin Research and Development Council's Bulletin, compiled by The Hague Statistical Office, world consumption rose 21½ per cent. compared with the previous twelve months. Consumption in the United States rose from 45,795 tons to 66,439 tons (an increase of 45.1 per cent.), while the United Kingdom figures rose from 20,890 tons to 22,113 tons (an increase of 5.9 per cent.). Decreases, small in both cases, were shown in the figures for France and Germany. World apparent consumption during the period in question increased from 119,750 tons to 145,492 tons.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £206 5s. to £206 10s.; Friday, £206 5s. to £206 7s. 6d.; Monday, £206 10s. to £206 15s.; Tuesday, £207 to £207 5s.; Wednesday, £207 15s. to £208.

Three Months.—Thursday, £202 15s. to £203; Friday, £202 10s. to £202 15s.; Monday, £202 10s. to £202 15s.; Tuesday, £202 15s. to £203; Wednesday, £202 5s. to £202 10s.

Spelter.—Quotations have risen during the week, probably due to hopes of further development in connection with the re-establishment of the International Zinc Cartel. However, little progress seems to have been made. Steady conditions prevail in the United States and buying is on a moderate scale.

Official quotations were as follow:—

Ordinary.—Thursday, £15 7s. 6d.; Friday, £15 2s. 6d.; Monday, £15 2s. 6d.; Tuesday, £15; Wednesday, £15.

Lead.—Rather featureless conditions are seen on this market and little change has occurred for several weeks. Production and consumption are believed to be fairly equally balanced. Quiet conditions also prevail in the United States.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £16 1s. 3d.; Friday, £16 1s. 3d.; Monday, £16 6s. 3d.; Tuesday, £16 5s.; Wednesday, £16 5s.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

440,050. Vereinigte Stahlwerke Akt.-Ges. Method of testing the ductility of metal sheets.

440,125. Jacyna, W. Railway-rail joint.

440,428. Midland Steel Products Company. Methods and apparatus for welding.

440,564. Arnold, C. (Ferro Enamel Corporation). Cleaning and pickling of metal articles.

440,609. Ges. für Linde's Eismaschinen Akt.-Ges. Enrichment of air, in particular furnace blast, with oxygen.

440,641. Hertel, Dr. E., and Becker, Dr. G. Method of forming protective layers on iron and steel articles.

440,732. Jesson, W. F., and Imperial Chemical Industries, Limited. Apparatus for degreasing metal and like non-absorbent articles.

Correction.—Mr. E. B. Ellis, author of the Paper "Foundry Products through the Microscope," published in our last week's issue, points out that a typescript error has occurred on page 320, centre column, where the figure 66.7 per cent. C should read 6.67 per cent. C.

TOR ROCK SAND

It is now possible to obtain from a deposit in the Midlands, a moulding sand possessing all the excellent characteristics of the Scottish Rock sands. This sand we have called Tor Rock Sand. It is well bonded, coarse in grain, and highly permeable.

The advantage this sand offers to iron founders in the Midlands and the South is obvious. Railway rates, which represent a high proportion of the cost of moulding sand when delivered are reduced considerably. Please write for full particulars and samples.

CHEMICAL ANALYSIS

Silica	86·8 %
Ferric Oxide	1·43%
Alumina	7·6 %
Lime	·22%
Magnesia	·18%
Titanic Oxide	·18%
Alkalies	1·8 %
Loss on ignition	1·6 %

MECHANICAL ANALYSIS

Very Coarse Sand (+ 1 mm)	16·5%
Coarse Sand (+·5 mm—1 mm)	16·0%
Medium Sand (+·25 mm—·5 mm)	11·0%
Fine Sand (+ ·1 mm—·25 mm)	30·0%
Silt Grade (+ ·01 mm—·1 mm)	7·0%
Clay Grade (—·01 mm)	19·5%

GENERAL REFRACTORIES Ltd.,

Genefax House, Sheffield.

Telephone: Sheffield 31113 (6 lines). Telegrams: "Genefax, Sheffield."

London Office:
Russell House,
Adelphi, W.C.2.
Telephone: Temple Bar 7361.
Telegrams:
"Genefax, Rand-London."

Scottish Office:
156, St. Vincent St.,
Glasgow.
Telephone: 5250.
Telegrams:
"Genefax, Glasgow."

South Wales Office:
11, Wind St.,
Swansea.
Telephone: 3680.
Telegrams:
"Genefax, Swansea."

MANUFACTURERS OF HEAT RESISTING AND HEAT INSULATING MATERIALS OF EVERY DESCRIPTION.

RAW MATERIALS—PRICE LIST

(Wednesday, April 29, 1936)

COPPER

	£	s.	d.
Standard cash	37	0	0
Three months	37	6	3
Electrolytic	41	7	6
Tough	39	15	0
Best selected	40	5	0
Sheets	70	0	0
India	51	5	0
Wire bars	41	15	0
Ingot bars	41	15	0
H.C. wire rods	45	5	0
Off. av. cash, Mar.	36	1	5 5/11
Do., 3 mths., Mar.	36	8	5 3/22
Do., Sttlmnt., Mar.	36	1	3
Do., Electro, Mar.	40	8	6 1/22
Do., B.S., Mar.	40	0	3 1/2
Do., wire bars, Mar.	40	12	7 5/11
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			6¼d.

BRASS

Solid drawn tubes	9½d.
Brazed tubes	11½d.
Rods, drawn	8½d.
Rods, extd. or rlld.	8d.
Sheets to 10 w.g.	8d.
Wire	7¾d.
Rolled metal	7½d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5¼d.
Do. 4 × 3 Sheets	5¼d.

TIN

	£	s.	d.
Standard cash	207	15	0
Three months	202	5	0
English	208	0	0
Bars	209	0	0
Straits	209	5	0
Australian	207	15	0
Eastern	209	2	6
Banca	209	5	0
Off. av. cash, Mar.	213	7	3 3/11
Do., 3 mths., Mar.	204	14	8 13/22
Do., Sttlmt., Mar.	213	5	2 8/11

SPELTER

	£	s.	d.
Ordinary	15	0	0
Remelted	13	5	0
Hard	12	0	0
Electro 99.9	17	1	3
English	15	17	6
India	12	15	0
Zinc dust	19	10	0
Zinc ashes	4	5	0
Off. aver., Mar.	16	1	8 35/44
Aver. spot, Mar.	15	19	7 10/11

LEAD

	£	s.	d.
Soft foreign ppt.	16	5	0
Empire (nom.)	17	0	0
English	18	5	0
Off. average, Mar.	16	13	9
Average spot, Mar.	16	12	1 1/11

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.		£	s.	d.
Zinc sheets, English	24	10	0	to	25	0	0
Do., V.M. ex-whse.	24	10	0	to	25	0	0
Rods					27	10	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	72	0	0	to	73	0	0
Chinese, ex-whse.					58	0	0
Crude, c.i.f.					29	0	0

QUICKSILVER

	£	s.	d.		£	s.	d.
Quicksilver	12	0	0	to	12	11	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.		£	s.	d.
Ferro-silicon—							
25%					8	17	6
45/50%					12	15	0
75%					17	17	6
Ferro-vanadium—							
35/50%					12/8 lb.		Va.
Ferro-molybdenum—							
70/75% carbon-free					4/6 lb.		Mo.
Ferro-titanium—							
20/25% carbon-free					9d. lb.		
Ferro-phosphorus, 20/25%				£21	0	0	
				to £22	0	0	
Ferro-tungsten—							
80/85%					3/- lb.		
Tungsten metal powder—							
98/99%					3/3 lb.		
Ferro-chrome—							
2/4% car.				33	0	0	
4/6% car.				21	15	0	
6/8% car.				21	0	0	
8/10% car.				21	0	0	
Ferro-chrome—							
Max. 2% car.				33	10	0	
Max. 1% car.				36	5	0	
Max. 0.70% car.				37	5	0	
70% carbon-free				9½d. lb.			
Nickel—99.5/100%				£200 to £205			
"F" nickel shot				£184	0	0	
Ferro-cobalt, 98/99%				6/3 to 6/9 lb.			
Metallic chromium—							
96/98%				2/5 lb.			
Ferro-manganese (net)—							
76/80% loose	£11	5	0	to 11	15	0	
76/80% packed	£12	5	0	to 12	15	0	
76/80% export	(nom.)	£10	5	0			
Metallic manganese—							
94/96% carbon-free				1/3 lb.			

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	5	0	to	3	6	0
Mixed iron and steel	3	0	0	to	3	1	6
Heavy cast iron	2	18	0	to	3	0	0
Good machinery	3	2	6	to	3	5	0
Cleveland—							
Heavy steel				2	17	6	
Steel turnings				2	0	0	
Heavy cast iron	3	0	0	to	3	2	6
Heavy machinery				3	5	0	
Midlands—							
Light cast-iron scrap	2	12	6	to	2	15	0
Heavy wrought iron	3	7	6	to	3	10	0
Steel turnings				2	2	6	
Scotland—							
Heavy steel				2	17	6	
Ordinary cast iron				3	9	0	
Engineers' turnings				2	2	6	
Cast-iron borings	1	17	6	to	1	18	6
Wrot-iron piling				3	10	0	
Heavy machinery	3	11		to	3	12	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.		£	s.	d.
Copper (clean)				31	0	0	
Brass				20	10	0	
Lead (less usual draft)				14	10	0	
Tea lead				10	0	0	
Zinc				9	10	0	
New aluminium cuttings				75	0	0	
Brazier copper				28	0	0	
Gunmetal				30	0	0	
Hollow pewter				160	0	0	
Shaped black pewter				120	0	0	

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	72/6
,, No. 3	70/-
,, at Falkirk	70/-
,, at Glasgow	73/-
,, No. 4	69/-
Forge No. 4	69/-
Hematite No. 1	77/-
Hematite M/Nos.	76/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	77/-
,, d/d Birm.	88/6
Malleable iron d/d Birm.	119/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	71/-
,, No. 3 fdry.	75/-
Northants forge	68/6
,, fdry. No. 3	72/6
,, fdry. No. 1	75/6
Derbyshire forge	71/-
,, fdry. No. 3	75/-
,, fdry. No. 1	78/-
Scotland—	
Foundry, No. 1, f.o.t.	81/6
,, No. 3, f.o.t.	79/-
Hem. M/Nos. d/d	77/-
Sheffield (d/d district)—	
Derby forge	68/6
,, fdry. No. 3	72/6
Lincs forge	68/6
,, fdry. No. 3	72/6
W.C. hematite	90/-
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	78/-
Staffs fdry. No. 3	78/-
Northants fdry. No. 3	76/6
Cleveland fdry. No. 3	78/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	89/-
Clyde, No. 3	89/-
Monkland, No. 3	89/-
Summerlee, No. 3	89/-
Eglinton, No. 3	89/-
Gartsherrie, No. 3	89/-
Shotts, No. 3	89/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)					10	2	6
Nut and bolt iron	8	10	0	to	9	0	0
Hoops			11	0	0	and up.	
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip			11	0	0	and up.	
Bolts and nuts, ¾ in. × 4 in.			15	15	0	and up.	
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	9	5	0	to	9	7	6
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					9	1	0
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	10	0
Hoops (Staffs)					9	16	0
Black sheets, 24g. (4-t. lots)					11	10	0
Galv. cor. shts. (,,)					13	10	0
Galv. flat shts. (,,)					14	0	0
Galv. fencing wire, 8g. plain					15	0	0
Billets, soft			5	17	6	and up.	
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	15	0	to	6	5	0
Tin bars	5	15	0	to	6	5	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.31
No. 2 foundry, Valley	19.50
No. 2 foundry, Birm.	15.50
Basic, Valley	19.00
Malleable, Valley	19.50
Grey forge, Valley	19.00
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	36.37½
Billets	28.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.10
Plain wire	2.40
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 32/-
,, furnace	20/- to 21/-
Durham foundry	23/6 to 24/6
,, furnace	21/-
Scotland, foundry	30/-
,, furnace	25/- to 26/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	18/9
,,	28×20 ,,	37/6
,,	20×10 ,,	27/-
,,	18¾×14 ,,	19/6
C.W.	20×14 ,,	15/6 to 16/3
,,	28×20 ,,	34/3
,,	20×10 ,,	23/-
,,	18¾×14 ,,	15/9 to 16/-

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, at'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.		
April 23 ..	37	10	0	inc.	7/6
„ 24 ..	37	8	9	dec.	1/3
„ 27 ..	37	10	0	inc.	1/3
„ 28 ..	37	3	9	dec.	6/3
„ 29 ..	37	0	0	„	3/9

Electrolytic Copper

	£	s.	d.		
April 23 ..	41	10	0	inc.	5/-
„ 24 ..	41	10	0	No	change
„ 27 ..	41	10	0	„	„
„ 28 ..	41	5	0	dec.	5/-
„ 29 ..	41	7	6	inc.	2/6

Standard Tin (cash)

	£	s.	d.		
April 23 ..	206	5	0	dec.	5/-
„ 24 ..	206	5	0	No	change
„ 27 ..	206	10	0	inc.	5/-
„ 28 ..	207	0	0	„	10/-
„ 29 ..	207	15	0	„	15/-

Tin (English ingots)

	£	s.	d.		
April 23 ..	206	5	0	dec.	10/-
„ 24 ..	206	5	0	No	change
„ 27 ..	206	15	0	inc.	10/-
„ 28 ..	207	5	0	„	10/-
„ 29 ..	208	0	0	„	15/-

Spelter (ordinary)

	£	s.	d.		
April 23 ..	15	7	6	inc.	5/-
„ 24 ..	15	2	6	dec.	5/-
„ 27 ..	15	2	6	No	change
„ 28 ..	15	0	0	dec.	2/6
„ 29 ..	15	0	0	No	change

Spelter (Electro, 99.9 per cent.)

	£	s.	d.		
April 23 ..	17	7	6	inc.	6/3
„ 24 ..	17	3	9	dec.	3/9
„ 27 ..	17	3	9	No	change
„ 28 ..	17	1	3	dec.	2/6
„ 29 ..	17	1	3	No	change

Lead (soft foreign, prompt)

	£	s.	d.		
April 23 ..	16	1	3	inc.	1/3
„ 24 ..	16	1	3	No	change
„ 27 ..	16	6	3	inc.	5/-
„ 28 ..	16	5	0	dec.	1/3
„ 29 ..	16	5	0	No	change

Lead (English)

	£	s.	d.		
April 23 ..	18	0	0	No	change
„ 24 ..	18	0	0	„	„
„ 27 ..	18	5	0	inc.	5/-
„ 28 ..	18	5	0	No	change
„ 29 ..	18	5	0	„	„

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1899	6 15 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 12 6	7 12 6	7 12 6	7 12 6	8 0 0	7 6 5½
1900	6 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 0	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 5 0	6 15 0	6 10 0	7 16 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 8 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 4 0	8 4 0	8 12 6	8 12 6	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1932	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1933	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1934	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1935	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1936	8 15 0	8 15 0	8 15 0	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

BATH Moulder wants similar position. Block, squad, finishing, without blacking.—Box 690, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN, non-ferrous foundry; 12 years' experience with Government contracts, gun, brass and phos. bronzes.—Box 700, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager or Foreman; 12 years' experience in complete control in the manufacture of rainwater and soil goods, builders' and general engineers' castings; sound cupola practice; up-to-date methods; first-class references.—Box 698, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG Foundry Manager, practical man, ambitious and anxious for progress, with experience of modern methods of manufacture, wishes to join the staff of another foundry. Grey-iron and alloy cast-iron castings up to 50 tons. Conversant with output of 100 tons per week. Moderate salary.—Box 684, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Draughtsman wanted. Must be fully conversant with the manufacture of ranges, mantel registers and other classes of light castings. Apply stating age, experience, and salary required.—Box 692, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Engineer with modern experience required as Assistant to Foundry Manager of large ferrous and non-ferrous foundry on North-East Coast. Age 25 to 35. Modern machine-shop experience and sales estimating desirable. Apply stating age, experience, and salary required, to Box 694, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

VITREOUS ENAMELLING.—The services are required of a man with extensive knowledge and experience in the manufacture and use of vitreous enamels (cast iron, sheet iron and steel). The vacancy is an exceptional one, a first-class man is wanted, and the advertisers are prepared to pay a good salary. Intending applicants are asked in the first instance to send a summarised statement of their qualifications to Box 686, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

ASSISTANT Foundry Manager desires re-engagement. Has had charge of mechanised plant, also general foundry experience. Cupola control. Sound technical training. (275)

SITUATIONS VACANT AND WANTED.—*Contd.*

EXPERIENCED Foundry Manager requires position. Sound technical and practical training. Experienced as manager of well-known malleable and also important grey-iron repetition foundries. Can undertake all management duties, practical, technical and commercial. (276)

POSITION required as Foundry Foreman. Marine engineering and general engineering experience of varied character. (277)

FOUNDRY Manager requires re-engagement. Sound experience in motor cylinders and repetition work, general engineering up to 20 tons, steelfoundry and non-ferrous. (278)

BUSINESS FOR SALE

FOR SALE.—Small Iron Foundry in the North Midlands, specialising in grey-iron castings up to 10 cwts. Going concern. Owner desiring retirement. For particulars apply: Box 688, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

FOUNDRY Cupola, 5 ft., wanted. State price and where can be inspected.—Box 696, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOR SALE.—Three "Ajax" No. 9 Turnover Moulding Machines and one "Ajax" Stripping-Plate Moulding Machine with vibrator, complete with all accessories. Can be seen under working conditions. Price £50 each. —THOMAS BROADBENT & SONS, LIMITED, Huddersfield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.

Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.

All complete with Air Compressors, etc.

Pneulec Royer Sand Thrower, size No. 1.

Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.

Three Mumford Yoke Headpress Pneumatic Moulding Machines.

Two Herbert Whizzer Sand Disintegrators.

Two Brealey Type ditto.

Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.

Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.

500 Electric Motors, Dynamos, Rotary Converters, etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

THOS. W. WARD LTD.

Pneu. 12-in. cyl. Jackman PLAIN JOLT-RAM MOULDING MACHINE; table 5' square.

Grimes Hand-ram Turnover MOULDING MACHINE; take boxes from 16" sq. up to 26" x 18"; 10" clear draw.

Three LANCS. BOILERS; 30' x 8'; 140 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

FOR SALE.—10,000 tons of Ganister, best quality; also High-Silica Moulding.—For particulars—

R. SCOTT,
Derwent Quarries,
Consett, Co. Durham.

FOR SALE.—One 4-ton Foster Steel Tipping Ladle, top and bottom pourer. One Evans 3-ton Tipping Ladle, 42 in. deep, 37 in. tapering to 29 in. dia. Bogey for carrying ladles suitable for track 2 ft. 6 in. between rails.—Apply: E. HIND, Imperial Works, South Bank-on-Tees.

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries. — FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. A new edition now ready. Price 42s. cloth bound, 52s. Morocco. Order your copy now.——INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

SAND BLAST

Twelve reconditioned Tilghman Barrel Plants, sizes 12"×18" to 60"×40". Low prices.
New 8' cube Room Plant complete, price **£160.**
Good 6' square cast-iron Room Plant complete, price **£100.**
Complete 12' square Room Plant for sale cheap.

CUPOLAS

Two new 30" diam. CUPOLAS with A.C. Fans

PLEASE WRITE FOR OUR NEW CATALOGUE GIVING DETAILS OF OVER 100 BARGAINS IN MODERN FOUNDRY PLANT FOR IMMEDIATE DELIVERY.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!

PETER — WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(Founded 1838)
SWISS COTTAGE, LONDON, N.W.3